



1114 Industry Dr. Seattle WA 98188 206/575-1830

USER'S
GUIDE

Microsoft®

MS™-DOS Operating System

User's Guide



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Part No. 900-000499

MS-DOS Version 2.0 Files

Your MS-DOS system comes on two disks which contain the following files. (See Section 1.6 for a description of each file.)

Disk 1

IO.SYS
MSDOS.SYS
COMMAND.COM
HDISK.DEV
CONFIG.SYS
CHKDSK.COM
DEBUG.COM
EDLIN.COM
PRINT.COM
RECOVER.COM
SYS.COM
MORE.COM
DISKCOPY.COM
RENDIR.COM
BACKUP.COM
ASM.COM
TRANS.COM
HEX2BIN.COM
INSTALL.COM
MEMTEST.COM
FORMAT.COM
SHIPZONE.COM
EXE2BIN.EXE
SORT.EXE
FIND.EXE
FC.EXE
FUNKEY.EXE
LIB.EXE
CREF.EXE

Disk 2

IOSEG
MAKIOSYS.BAT
HDISK.DEV
PUTIO.BAT
MASM.EXE
LINK.EXE
EXE2BIN.EXE
INSTALL.COM
FDISK.ASM
IO.ASM
INIT.ASM
CONIO.ASM
AUXIO.ASM
PRNIO.ASM
TIME.ASM
HDISK.ASM
SYSINIT.OBJ
SYSIMES.OBJ
FORMAT.OBJ
FORMES.OBJ
IO.OBJ
HDISK.OBJ
FDISK.OBJ
CONIO.OBJ
AUXIO.OBJ
PRNIO.OBJ
TIME.OBJ
INIT.OBJ
IODEF.ASM
LINKIO.BAT

System Requirements

The MS-DOS operating system requires an 8086 or 8088 microcomputer system and at least two disk drives. The operating system itself runs in and requires 64K bytes of memory.

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CHAPTER 1
INTRODUCTION

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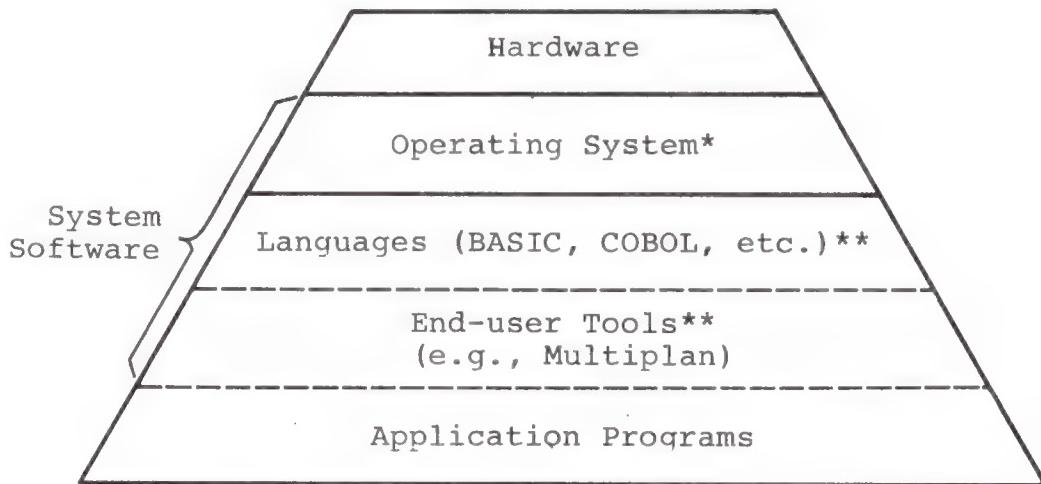
1.1 WHAT IS MS-DOS?

Microsoft(R) MS(tm)-DOS is a disk operating system for 8086/8088-based computers. Through MS-DOS, you communicate with the computer, disk drives, and printer, managing these resources to your advantage.

1.2 WHAT IS AN OPERATING SYSTEM?

An operating system is your "silent partner" when you are using the computer. It provides the interface between the hardware and both you (the user) and the other system software. An operating system can be compared to the electricity in a house--you need it for the toaster and the blender to work, but you are not always aware that it's there.

An operating system (OS) is the piece of system software most closely associated with the hardware. The OS is unique to the microprocessor (computer). For example, MS-DOS runs on the 8086/8088 microprocessor family and will not run on another microprocessor (like the Z8000) unless major parts of the OS are rewritten. The Figure 1 illustrates how the hardware, the system software and the application software are related.



*Must adapt to new hardware

**If adapted to operating system, these don't change

Figure 1. Hardware/Software Relationships

MS-DOS is a disk operating system that enables you to create and keep track of files, run and link programs, and access

peripheral devices (for example, printers and disk drives) that are attached to your computer. MS-DOS is an important advance in microprocessor operating systems.

1.3 WHY IS MS-DOS SO IMPORTANT?

All Microsoft languages (BASIC Interpreter, BASIC Compiler, FORTRAN, COBOL, Pascal) are available under MS-DOS. Users of MS-DOS are assured that their operating system will be the first that Microsoft will support when any new products or major releases are announced.

1.4 ABOUT THIS MANUAL

This manual describes MS-DOS and how to use it. This chapter introduces some basic MS-DOS concepts; Chapter 2 discusses how to start using MS-DOS and how to format and back up your disks.

Chapter 3 tells you about files--what they are and how to use them. Chapters 4 through 6 introduce MS-DOS commands and Chapter 7 describes the line editor, EDLIN. Read these chapters carefully--they contain information on protecting your data, system commands, and the MS-DOS editing commands.

Chapter 8 explains how to use the MS-DOS File Comparison utility, FC. This utility is helpful when you need to compare the contents of two source or binary files.

If you are writing programs and want to link separately-produced object modules and create relocatable modules, Chapter 9 describes a useful MS-DOS utility, MS-LINK.

Appendices to this manual include disk error messages, ANSI escape sequences, and information on how to configure your system.

For more details, the MS-DOS Programmer's Reference Manual in the MS-DOS Technical Reference binder describes system calls and interrupts and how to install device drivers.

1.5 SYNTAX NOTATION

The following syntax notation is used throughout this manual in descriptions of command and statement syntax:

- [] Square brackets indicate that the enclosed entry is optional.
- < > Angle brackets indicate that you supply the text for this entry. When the angle brackets enclose lowercase text, type in an entry defined by the text; for example, <filename>. When the angle brackets enclose upper case text, you must press the key named by the text; for example, <RETURN>.
- { } Braces indicate that you have a choice between two or more entries. At least one of the entries enclosed in braces must be chosen unless the entries are also enclosed in square brackets.
- ... Ellipses indicate that an entry may be repeated as many times as needed or desired.
- | A bar indicates an OR statement in a command. When used with an MS-DOS filter, the bar indicates a pipe.
- CAPS Capital letters indicate portions of statements or commands that must be entered exactly as shown.

All other punctuation, such as commas, colons, slash marks, and equal signs must be entered exactly as shown.

1.6 MS-DOS FILES

The MS-DOS disk contains the following files:

<u>File Name</u>	<u>Function of File</u>
ASM.COM	SCP Small Assembler
AUXIO.ASM	Auxiliary driver source code
AUXIO.OBJ	Auxiliary driver object code
BACKUP.COM	Incremental backup utility for floppy disks and hard disks
CHKDSK.COM	Checks disks
COMMAND.COM	MS-DOS command interpreter
CONFIG.SYS	MS-DOS configuration file
CONIO.ASM	Console driver source code
CONIO.OBJ	Console driver object code
CREF.EXE	Cross-reference utility

<u>File Name</u>	<u>Function of File</u>
DEBUG.COM	Debugger
DISKCOPY.COM	Backup utility for floppy disks
EDLIN.COM	Line editor
EXE2BIN.EXE	Converts .EXE files
FC.EXE	Compares files
FDISK.ASM	Floppy disk driver source code
FDISK.OBJ	Floppy disk driver source code
FIND.EXE	Finds a string in text
FORMAT.COM	Formats disks
FORMAT.OBJ	FORMAT object code
FORMES.OBJ	FORMAT messages object code
FUNKEY.EXE	Defines editing keys
HDISK.ASM	Hard disk driver source code
HDISK.DEV	Hard disk installable device driver file
HDISK.OBJ	Object code for HDISK.ASM
HEX2BIN.COM	Converts hexadecimal to binary
INIT.ASM	Changes FORMAT source code
INIT.OBJ	Object module of INIT.ASM
INSTALL.COM	Copies file to IO.SYS file
IO.ASM	I/O system header source code
IO.OBJ	Object code for IO.ASM
IO.SYS	I/O system binary code
IODEF.ASM	I/O system configuration file
IOSEG	I/O segment address (used with EXE2BIN)
LIB.EXE	Manages library
LINK.EXE	Linker
LINKIO.BAT	I/O system link execution file
MAKIOSYS.BAT	I/O system generation file
MASM.EXE	Microsoft Macro Assembler
MEMTEST.COM	Tests memory
MORE.COM	Reviews text
MSDOS.SYS	MS-DOS executable operating system
PRINT.COM	Print spooler
PRNIO.ASM	Printer driver source code
PRNIO.OBJ	Object code for PRNIO.ASM
PUTIO.BAT	Installs I/O system
RECOVER.COM	Recovers disks
RENDIR.COM	Renames directory
SHIPZONE.COM	Prepares hard disk for shipping
SORT.EXE	Sorts text
SYS.COM	Transfers system
SYSIMES.OBJ	Object module for IO.SYS
SYSINIT.OBJ	Object module for IO.SYS
TIME.ASM	Clock driver source code
TIME.OBJ	Clock driver object code
TRANS.COM	Z80-to-8086 translator

You will recognize this list of files when you have learned the DIR (Show Directory) command described in the next chapter.

In the next chapter, you will learn how to start your MS-DOS system and how to format and back up your disks.

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GETTING STARTED

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2.1 WHAT HAPPENS WHEN YOU FIRST LOAD MS-DOS?

To load MS-DOS, insert your master disk in drive A and push RESET. Loading MS-DOS takes about 2 seconds.

Once MS-DOS has been loaded, the system searches the MS-DOS disk for the COMMAND.COM file and loads it into memory. The COMMAND.COM file is a program that processes the commands you enter and then runs the appropriate programs. It is also called the command processor.

When the command processor is loaded, you will see the following display on your screen (the underscore represents the cursor):

```
MS-DOS Version 2.02
Copyright 1981,82,83 Microsoft Corp.
```

```
Command V. 2.02
Current date is Tue 1-01-1981
Enter new date:_
```

You must now enter today's date and time at your terminal.

2.2 HOW TO ENTER THE DATE AND TIME

Type today's date in an mm-dd-yy format, where:

mm is a one- or two-digit number from 1-12
(representing month)

dd is a one- or two-digit number from 1-31
(representing day of month)

yy is a two-digit number from 80-99 (the 19 is assumed), or a four-digit number from 1980-2099 (representing year)

Any date is acceptable in answer to the new date prompt as long as it follows the above format. Separators between the numbers can be hyphens (-) or slashes (/). For example:

6-1-82 or 06/01/82

are both acceptable answers to the "Enter new date:" prompt. If you enter an invalid date or form of date, the system will prompt you again with "Enter new date:".

After you respond to the new date prompt and enter your

answer by pressing the <RETURN> key (or <ENTER> key on some terminals), you will see a prompt similar to this:

```
Current time is 8:30:14.32
Enter new time:_
```

Enter the current time in the hh:mm format, where:

hh is a one- or two-digit number from 0-23
(representing hours)

mm is a one- or two-digit number from 0-59
(representing minutes)

MS-DOS uses this time value to keep track of when you last updated and/or created files on the system. Notice that MS-DOS uses military time; for instance, 1:30 p.m. is written 13:30.

Example:

```
Current time is 0:00:14.32
Enter new time: 9:05
```

You should only use the colon (:) to separate hours and minutes. If you enter an invalid number separator, MS-DOS will repeat the prompt.

NOTE

If you make a mistake while typing, press the control key on your keyboard, hold it down, and then press the "C" key. This <CONTROL-C> function will abort your current entry. You can then re-answer the prompt or type another command. To correct a line before you press <RETURN>, use the <BACKSPACE> key to erase one letter at a time.

You have now completed the steps for starting MS-DOS.

2.3 HOW TO CHANGE THE DEFAULT DRIVE

After you have answered the new time prompt, a message is displayed that looks like this:

A:_

The A: is the MS-DOS prompt from the command processor. It tells you that MS-DOS is ready to accept commands. If you have inserted the MS-DOS disk into a drive other than A, the command processor prompt will reflect that drive (for example, B:). However, usually you will load MS-DOS in drive A.

The A in the previous prompt represents the default disk drive. This means that MS-DOS will search only the disk in drive A for any filenames you may enter and will write files to that disk unless you specify a different drive. You can ask MS-DOS to search the disk in drive B by changing the drive designation or by specifying B: in a command. To change the disk drive designation, enter the new drive letter followed by a colon. For example:

```
A:      (MS-DOS prompt)
A:B:    (you have typed B: in response to
          the prompt)
B:      (system responds with B: and drive B
          is now the default drive)
```

The system prompt B: will appear and MS-DOS will search only the disk in drive B until you specify a different default drive.

2.4 HOW TO FORMAT YOUR DISKS

You must "format" all new floppy disks before they can be used by MS-DOS. If you have a hard disk drive in your computer, it has already been formatted at the factory.

Both floppy disks and hard disks are formatted with the MS-DOS FORMAT command. The FORMAT command changes the disk to a format that MS-DOS can use; it also analyzes the disk for defective tracks. If the disk is not already blank, formatting it will destroy any data that exists on the disk.

However, it is recommended that the MS-DOS DELETE command be used for deleting all data on a floppy disk or the RMDIR

command for deleting all directories on a hard disk. Refer to Chapter 5, MS-DOS Commands, for more information on the DELETE and RMDIR commands.

2.4.1 The FORMAT Command

The syntax of the FORMAT command is:

```
FORMAT [d:]
```

where:

d: is the drive designation (the drive that contains the disk to be formatted)

Note that the brackets identify optional information. If you do not specify a disk drive (for example, A: or B:), MS-DOS will format the disk in the default drive.

With the MS-DOS disk already in drive A, you are ready to format your new blank disk. If you are formatting a floppy disk, the following command will format the disk in drive B for double density:

```
FORMAT B:/D
```

MS-DOS issues the following message:

```
Insert new disk for drive B:  
and strike any key when ready
```

After you insert the new floppy disk in drive B and press a key on the keyboard, the system responds:

```
Formatting...
```

while MS-DOS is formatting your disk. If you add the /V switch to the FORMAT command, MS-DOS will ask for the volume label of the disk. (See below.) The /S switch tells MS-DOS to copy its system onto the new disk.

If you are formatting a hard disk, the following command will format the hard disk in drive C:

```
FORMAT C:
```

MS-DOS issues the following message:

Insert new disk for drive C:
and strike any key when ready

After a key on the keyboard, the system responds:

ARE YOU SURE YOU WANT TO FORMAT THIS HARD DISK?
(Y/N)

If you type Y, you will see this message:

Formatting...

while MS-DOS is formatting your disk. The /S switch tells MS-DOS to copy its system onto the new disk.

When the formatting is finished, MS-DOS will issue a message similar to this:

Formatting...Format complete
System transferred

Volume label (11 characters. RETURN for none)?

Volume labels are useful to identify disks--they are like a name tag for each disk. When you assign a unique volume label to a disk, you can always be sure that you know which disk you are using. The volume label you assign to a disk is displayed by issuing the MS-DOS VOL command (refer to Chapter 5, MS-DOS Commands, for more information on the VOL command). Type a volume label in response to the above prompt if you want to identify this disk, and press <RETURN>. An example of a volume label is PROGRAMS. If you do not want to attach a label to this disk, simply press the <RETURN> key. You will see on your screen a message similar to this:

1250304 bytes total disk space
1250304 bytes available on disk

Format another (Y/N)?_

Type Y to format another disk. Type N to end the FORMAT program.

2.5 HOW TO BACK UP YOUR DISKS

It is strongly recommended that you make backup copies of all your disks. If a disk becomes damaged or if files are accidentally erased, you will still have all of the information on your backup disk. You should make a backup copy of your MS-DOS disk also. You can back up disks by using the DISKCOPY command for floppy disks or the BACKUP command for hard disks.

2.5.1 The DISKCOPY Command (Floppy Disks)

The DISKCOPY command copies the contents of a floppy disk onto another floppy disk. You can use this command to duplicate both the MS-DOS disk and a disk that contains your own files.

The format of the DISKCOPY command is:

```
DISKCOPY [drive1:] [drive2:]
```

Drive1 is the disk drive that contains the disk that you want to copy; drive2 is the disk drive that contains the blank or "destination" disk. The blank disk must be formatted prior to running DISKCOPY.

For example, if you want to make a copy of your MS-DOS disk which is in drive A, type

```
DISKCOPY A: B:
```

MS-DOS responds:

```
Insert source diskette into drive A  
Insert formatted target diskette into drive B:  
Press any key when ready
```

Make sure the MS-DOS disk is in drive A and insert a blank, formatted disk in drive B. Press any character key after you have done this and MS-DOS will begin copying the MS-DOS disk. After MS-DOS has copied the disk, MS-DOS displays:

```
Copy complete  
Copy another (Y/N)?
```

Type Y (for Yes) if you wish to copy another disk with DISKCOPY. If you type N (for No), the default drive prompt is displayed.

You now have a duplicate copy of your MS-DOS disk in drive B. This duplicate copy can be saved as your backup copy of the MS-DOS disk.

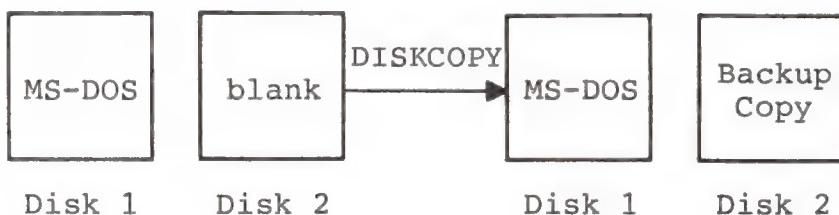


Figure 2. The DISKCOPY Command

Disks must be the same size and density to be copied with the DISKCOPY command. Refer to Chapter 5, MS-DOS Commands, for more information on the DISKCOPY command.

NOTE

If either of the disks that you are using has defective tracks, DISKCOPY will not work. Use the COPY command to back up your disks in these cases. (COPY will skip over defective tracks.) Refer to Chapter 5, MS-DOS Commands, for information on how to use COPY to back up your disks.

2.5.1 The BACKUP Command (Hard Disks)

The BACKUP command copies files from a hard disk onto floppy disks and produces a list of all files that were copied. The first time you use BACKUP, it will copy all files from your hard disk onto floppy disk. After that, it will copy only files that have changed since the last backup.

The format of the BACKUP command is:

```
BACKUP d: [d:]
```

The first drive specified is the hard disk drive; the second drive contains the blank disk on which the hard disk files will be copied. The blank disk must be formatted before running BACKUP.

For example, if you want to make a copy of the hard disk in

drive C onto a floppy disk in drive, type

BACKUP C: B:

The system responds:

```
C:\INDEX  
Insert new backup disk  
Strike any key when ready
```

Insert a blank, formatted disk in drive B. Press any key after you have done this. As each file is copied, you will see the filename on the screen. If necessary, you will be prompted to insert additional disks. Always use blank, formatted disks. After the hard disk is copied, you will see this message:

```
Backup complete  
INDEX.NEW is on last volume
```

BACKUP creates an index file which is a directory of your whole hard disk. This file, named INDEX, is placed on the root directory of the hard disk drive. To print a copy, type:

PRINT C:INDEX

Refer to Chapter 5, MS-DOS Commands, for more information on the BACKUP command.

2.6 AUTOMATIC PROGRAM EXECUTION

If you want to run a specific program automatically each time you start MS-DOS, you can do so with Automatic Program Execution. For example, you may want to have MS-DOS display the names of your files each time you load MS-DOS.

When you start MS-DOS, the command processor searches for a file named AUTOEXEC.BAT on the MS-DOS disk. This file is a program that MS-DOS will run each time MS-DOS is started. Chapter 4, Learning About Commands, tells you how to create an AUTOEXEC.BAT file.

2.7 FILES

2.7.1 What Is A File?

A file is a collection of related information. A file on your disk can be compared to a file folder in a desk drawer. For example, one file folder might contain the names and addresses of the employees who work in the office. You might name this file the Employee Master File. A file on your disk could also contain the names and addresses of employees in the office and could be named Employee Master File.

All programs, text, and data on your disk reside in files and each file has a unique name. You refer to files by their names. Chapter 3, More About Files, tells you how to name your files.

You create a file each time you enter and save data or text at your terminal. Files are also created when you write and name programs and save them on your disks.

2.7.2 How MS-DOS Keeps Track Of Your Files

The names of files are kept in directories on a disk. These directories also contain information on the size of the files, their location on the disk, and the dates that they were created and updated. The directory you are working in is called your current or working directory.

An additional system area is called the File Allocation Table. It keeps track of the location of your files on the disk. It also allocates the free space on your disks so that you can create new files.

These two system areas, the directories and the File Allocation Table, enable MS-DOS to recognize and organize the files on your disks. The File Allocation Table is copied onto a new disk when you format it with the MS-DOS FORMAT command and one empty directory is created, called the root directory.

2.7.3 The DIR (Show Directory) Command

If you want to know what files are on your disk, you can use the DIR command. This command tells MS-DOS to display all the files in the current directory on the disk that is named. For example, if your MS-DOS disk is in drive A and you want to see the listing for the current directory on

that disk, type:

DIR A:

MS-DOS will respond with a directory listing of all the files in the current directory on your MS-DOS disk. The display should look similar to this:

Volume in drive A is DOS 2-0

Directory of A:/

COMMAND	COM	16276	10-29-81	11:48a
DEBUG	COM	11534	10-28-82	9:21a
CHKDSK	COM	6272	10-26-82	12:12p
SYS	COM	1400	10-29-82	6:30p
EDLIN	COM	4419	1-01-80	12:41a
RECOVER	COM	2281	10-29-82	5:37p
PRINT	COM	3899	10-27-82	12:19p
LINK	EXE	41856	8-31-82	1:14p
FORMAT	COM	5605	10-28-82	9:55a
SORT	EXE	1280	10-27-82	3:18p
MORE	COM	291	10-27-82	3:20p
FIND	EXE	5888	01-01-80	12:57a
CONFIG	SYS	33	10-18-82	5:02p
EXE2BIN	EXE	5888	10-27-82	12:53p
FC	EXE	10624	10-27-82	7:00p
20 File(s)		23040 bytes free		

NOTE

Two MS-DOS system files, IO.SYS and MSDOS.SYS, are "hidden" files and will not appear when you issue the DIR command.

You can also get information about any file on your disk by typing DIR and a filename. For example, if you have created a file named MYFILE.TXT, the command

DIR MYFILE.TXT

will give you a display of all the directory information (name of file, size of file, date last edited) for the file MYFILE.TXT.

For more information on the DIR command, refer to Chapter 5, MS-DOS Commands.

2.7.4 The CHKDSK (Check Disk) Command

The MS-DOS command CHKDSK is used to check your disks for consistency and errors, much like a secretary proofreading a letter. CHKDSK analyzes the directories and the File Allocation Table on the disk that you specify. It then produces a status report of any inconsistencies, such as files which have a non-zero size in their directory but really have no data in them.

To check the disk in drive A, type:

CHKDSK A:

MS-DOS will display a status report and any errors that it has found. An example of this display and more information on CHKDSK can be found in the description of the CHKDSK command in Chapter 5. You should run CHKDSK occasionally for each disk to ensure the integrity of your files.

2.8 HOW TO TURN THE SYSTEM OFF

There is no "logoff" command in MS-DOS. To end your terminal session, open the disk drive doors and remove the disks. Then, simply turn off your terminal and computer.

NOTE

Always remove your disks from the disk drives before you turn off your computer.

Summary of Commands in This Chapter

COMMAND	PURPOSE	SYNTAX
FORMAT	Formats disks for MS-DOS	FORMAT [d:]
DISKCOPY	Copies floppy disk files	DISKCOPY [drive1:] [drive2:]
BACKUP	Copies hard disk files	BACKUP d: [d:]
DIR	Lists directory information	DIR [d:] [filename]
CHKDSK	Checks for errors on disk	CHKDSK [d:]

In the next chapter, you will learn more about MS-DOS files.

CHAPTER 3
MORE ABOUT FILES

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In Chapter 2, you learned that directories contain the names of your files. In this chapter, you will learn how to name and copy your files. You will also learn more about the MS-DOS hierarchical directory structure which makes it easy for you to organize and locate your files.

3.1 HOW TO NAME YOUR FILES

The name of a typical MS-DOS file will look like this:

NEWFILE.EXE

The name of a file consists of two parts. The filename is NEWFILE and the filename extension is .EXE.

A filename can be from 1 to 8 characters long. The filename extension can be three or fewer characters. You can type any filename in small or capital letters and MS-DOS will translate these letters into uppercase characters.

In addition to the filename and the filename extension, the name of your file may include a drive designation. A drive designation tells MS-DOS to look on the disk in the designated drive to find the filename typed. For example, to find directory information about the file NEWFILE.EXE which is located on the disk in drive A (and drive A is NOT the default drive), type the following command:

DIR A:NEWFILE.EXE

Directory information about the file NEWFILE.EXE is now displayed on your screen.

If drive A is the default drive, MS-DOS will search only the disk in drive A for the filename NEWFILE and so the drive designation is not necessary. A drive designation is needed if you want to tell MS-DOS to look on the other drive to find a file.

Your filenames will probably be made up of letters and numbers, but other characters are allowed, too. Legal characters for filename extensions are the same as those for filenames. Here is a complete list of the characters you can use in filenames and extensions:

A-Z	0-9	\$	&	#
%	'	()	-	@
^	{ }	~	`	!

All of the parts of a filename comprise a file specification. The term file specification (or filespec) will be used in this manual to indicate the following filename format:

[<drive designation:>]<filename>[<.filename extension>]

Remember that brackets indicate optional items. Angle brackets (<>) mean that you supply the text for the item. Note that the drive designation is not required unless you need to indicate to MS-DOS on which disk to search for a specific file. You do not have to give your filename a filename extension.

Examples of file specifications are:

B:MYPROG.COB
A:YOURPROG.EXT
A:NEWFILE.
TEXT

3.2 WILD CARDS

Two special characters (called wild cards) can be used in filenames and extensions: the asterisk (*) and the question mark (?). These special characters give you greater flexibility when using filenames in MS-DOS commands.

3.2.1 The ? Wild Card

A question mark (?) in a filename or filename extension indicates that any character can occupy that position. For example, the MS-DOS command

DIR TEST?RUN.EXE

will list all directory entries on the default drive that have 8 characters, begin with TEST, have any next character, end with the letters RUN, and have a filename extension of .EXE. Here are some examples of files that might be listed by the above DIR command:

TEST1RUN.EXE
TEST2RUN.EXE
TEST6RUN.EXE

3.2.2 The * Wild Card

An asterisk (*) in a filename or filename extension indicates that any character can occupy that position or any of the remaining positions in the filename or extension. For example:

```
DIR TEST*.EXE
```

will list all directory entries on the default drive with filenames that begin with the characters TEST and have an extension of .EXE. Here are some examples of files that might be listed by the above DIR command:

```
TEST1RUN.EXE  
TEST2RUN.EXE  
TEST6RUN.EXE  
TESTALL.EXE
```

The wild card designation *.* refers to all files on the disk. Note that this can be very powerful and destructive when used in MS-DOS commands. For example, the command DEL *.* deletes all files on the default drive, regardless of filename or extension.

Examples:

To list the directory entries for all files named NEWFILE on drive A (regardless of their filename extensions), simply type:

```
DIR A:NEWFILE.*
```

To list the directory entries for all files with filename extensions of .TXT (regardless of their filenames) on the disk in drive B, type:

```
DIR B:??????????.TXT
```

This command is useful if, for example, you have given all your text programs a filename extension of .TXT. By using the DIR command with the wild card characters, you can obtain a listing of all your text files even if you do not remember all of their filenames.

3.3 ILLEGAL FILERAMES

MS-DOS treats some device names specially, and certain 3-letter names are reserved for the names of these devices. These 3-letter names cannot be used as filenames or extensions. You must not name your files any of the following:

AUX	Used when referring to input from or output to an auxiliary device (such as a printer or disk drive).
CON	Used when referring to keyboard input or to output to the terminal console (screen).
LST or PRN	Used when referring to the printer device.
NUL	Used when you do not want to create a particular file, but the command requires an input or output filename.

Even if you add device designations or filename extensions to these filenames, they remain associated with the devices listed above. For example, A:CON.XXX still refers to the console and is not the name of a disk file.

3.4 HOW TO COPY YOUR FILES

Just as with paper files, you often need more than one copy of a disk file. The COPY command allows you to copy one or more files to another disk. You can also give the copy a different name if you specify the new name in the COPY command.

The COPY command can also make copies of files on the same disk. In this case, you must supply MS-DOS with a different filename or you will overwrite the file. You cannot make a copy of a file on the same disk unless you specify a different filename for the new copy.

The format of the COPY command is:

```
COPY filespec [filespec]
```

For example,

```
COPY A:MYFILE.TXT B:MYFILE.TXT
```

will copy the file MYFILE.TXT on disk A to a file named MYFILE.TXT on the disk in drive B. A duplicate copy of MYFILE.TXT now exists.

Figure 3 illustrates how to copy files to another disk:

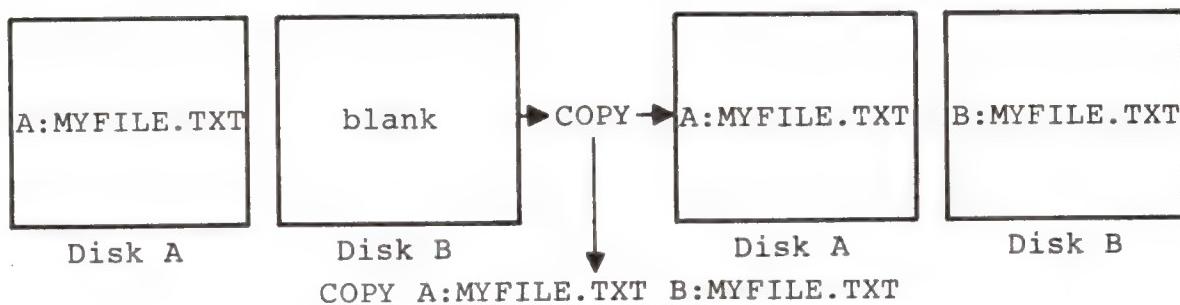


Figure 3. Copying Files to Another Disk

If you want to duplicate the file named MYFILE.TXT on the same disk, type:

```
COPY A:MYFILE.TXT A:NEWNAME.TXT
```

You now have two copies of your file on disk A--one named MYFILE.TXT and the other named NEWNAME.TXT. The following figure illustrates this example.

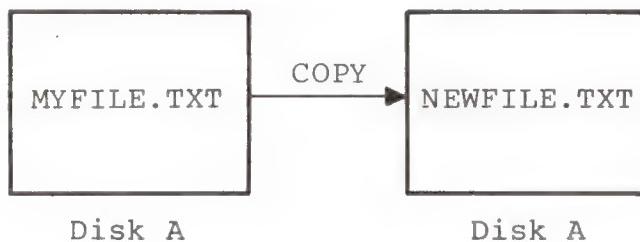


Figure 4. Copying Files on the Same Disk

You can also copy all files on a disk to another disk (i.e., make a backup copy) with the COPY command. Refer to Chapter 5, MS-DOS Commands, for more information on this process.

3.5 HOW TO PROTECT YOUR FILES

MS-DOS is a powerful and useful tool in processing your personal and business information. As with any information system, inadvertent errors may occur and information may be misused. If you are processing information that cannot be replaced or requires a high level of security, you should take steps to ensure that your data and programs are

protected from accidental or unauthorized use, modification, or destruction. Simple measures you can take--such as removing your disks when they are not in use, keeping backup copies of valuable information, and installing your equipment in a secure facility--can help you maintain the integrity of the information in your files.

3.6 DIRECTORIES

As you learned in Chapter 2, the names of your files are kept in a directory on each disk. The directory also contains information on the size of the files, their locations on the disk, and the dates that they were created and updated.

When there are multiple users on your computer, or when you are working on several different projects, the number of files in the directory can become large and unwieldy. You may want your own files kept separate from a co-worker's; or, you may want to organize your programs into categories that are convenient for you.

In an office, you can separate files by putting them in different filing cabinets; in effect, creating different directories of information. MS-DOS allows you to organize the files on your disks into directories. Directories are a way of dividing your files into convenient groups of files. For example, you may want all of your accounting programs in one directory and text files in another. Any one directory can contain any reasonable number of files, and it may also contain other directories (referred to as subdirectories). This method of organizing your files is called a hierarchical directory structure.

A hierarchical directory structure can be thought of as a "tree" structure: directories are branches of the tree and files are the leaves, except that the "tree" grows downward; that is, the "root" is at the top. The root is the first level in the directory structure. It is the directory that is automatically created when you format a disk and start putting files in it. You can create additional directories and subdirectories by following the instructions in Chapter 4, Learning About Commands.

The tree or file structure grows as you create new directories for groups of files or for other people on the system. Within each new directory, files can be added, or new subdirectories can be created.

It is possible for you to "travel" around this tree; for

instance, it is possible to find any file in the system by starting at the root and traveling down any of the branches to the desired file. Conversely, you can start where you are within the file system and travel towards the root.

The filenames discussed earlier in this chapter are relative to your current directory and do not apply system-wide. Thus, when you turn on your computer, you are "in" your directory. Unless you take special action when you create a file, the new file is created in the directory in which you are now working. Users can have files of the same name that are unrelated because each is in a different directory.

Figure 5 illustrates a typical hierarchical directory structure.

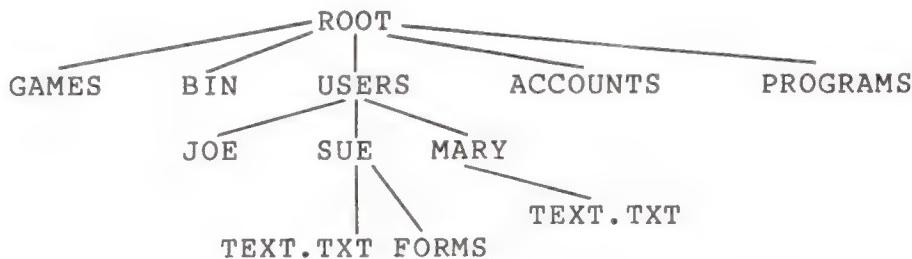


Figure 5. A Sample Hierarchical Directory Structure

The ROOT directory is the first level in the directory structure. You can create subdirectories from the ROOT by using the MKDIR command (refer to Chapter 5, MS-DOS Commands, for information on MKDIR). In this example, five subdirectories of ROOT have been created. These include:

A directory of games, named GAMES

A directory of all external commands, named BIN (refer to Chapter 4, Learning About Commands, for more information on the BIN directory)

A USER directory containing separate subdirectories for all users of the system

A directory containing accounting information, named ACCOUNTS

A directory of programs, named PROGRAMS

Joe, Sue, and Mary each have their own directories which are subdirectories of the USER directory. Sue has a subdirectory under the \USER\SUE directory named FORMS. Sue and Mary have files in their directories, each named

TEXT.TXT. Notice that Mary's text file is unrelated to Sue's.

This organization of files and directories is not important if you only work with files in your own directory; but if you work with someone else or on several projects at one time, the hierarchical directory structure becomes extremely useful. For example, you could get a list of the files in Sue's FORMS directory by typing:

```
DIR \USER\SUE\FORMS
```

Note that the backward slash mark (\) is used to separate directories from other directories and files.

To find out what files Mary has in her directory, you could type:

```
DIR \USER\MARY
```

3.7 FILENAMES AND PATHS

When you use hierarchical directories, you must tell MS-DOS where the files are located in the directory structure. Both Mary and Sue, for example, have files named TEXT.TXT. Each will have to tell MS-DOS in which directory her file resides if she wants to access it. This is done by giving MS-DOS a pathname to the file.

3.7.1 Pathnames

A simple filename is a sequence of characters that can optionally be preceded by a drive designation and followed by an extension. A pathname is a sequence of directory names followed by a simple filename, each separated from the previous one by a backslash (\).

The syntax of pathnames is:

```
[<d>:] [<directory>] \ [<directory...>] \ [<filename>]
```

If a pathname begins with a slash, MS-DOS searches for the file beginning at the root (or top) of the tree. Otherwise, MS-DOS begins at the user's current directory, known as the working directory, and searches downward from there. The pathname of Sue's TEXT.TXT file is \USER\SUE\TEXT.TXT.

When you are in your working directory, a filename and its corresponding pathname may be used interchangeably. Some sample names are:

\	Indicates the root directory.
\PROGRAMS	Sample directory under the root directory containing program files.
\USER\MARY\FORMS\1A	A typical full pathname. This one happens to be a file named 1A in the directory named FORMS belonging to the USER named MARY.
USER\SUE	A relative pathname; it names the file or directory SUE in subdirectory USER of the working directory. If the working directory is the root (\), it names \USER\SUE.
TEXT.TXT	Name of a file or directory in the working directory.

MS-DOS provides special shorthand notations for the working directory and the parent directory (one level up) of the working directory:

- . MS-DOS uses this shorthand notation to indicate the name of the working directory in all hierarchical directory listings. MS-DOS automatically creates this entry when a directory is made.
- .. The shorthand name of the working directory's parent directory. If you type:

DIR ..

then MS-DOS will list the files in the parent directory of your working directory.

If you type:

DIR ..\..

then MS-DOS will list the files in the parent's PARENT directory.

3.7.2 Pathing And External Commands

External commands reside on disks as program files. They must be read from the disk before they execute. (For more information on external commands, refer to Chapter 4, Learning About Commands.)

When you are working with more than one directory, it is convenient to put all MS-DOS external commands into a separate directory so they do not clutter your other directories. When you issue an external command to MS-DOS, MS-DOS immediately checks your working directory to find that command. You must tell MS-DOS in which directory these external commands reside. This is done with the PATH command.

For example, if you are in a working directory named \BIN\PROG, and all MS-DOS external commands are in \BIN, you must tell MS-DOS to choose the \BIN path to find the FORMAT command. The command

```
PATH \BIN
```

tells MS-DOS to search in your working directory and the \BIN directory for all commands. You only have to specify this path once to MS-DOS during your terminal session. MS-DOS will now search in \BIN for the external commands. If you want to know what the current path is, type the word PATH and the current value of PATH will be printed.

For more information on the MS-DOS command PATH, refer to Chapter 5, MS-DOS Commands.

3.7.3 Pathing And Internal Commands

Internal commands are the simplest, most commonly used commands. They execute immediately because they are incorporated into the command processor. (For more information on internal commands, refer to Chapter 4, Learning About Commands.)

Some internal commands can use paths. The following four commands, COPY, DIR, DEL, and TYPE have greater flexibility when you specify a pathname after the command.

The syntax of these four commands is shown below.

```
COPY <pathname pathname>
```

If the second pathname to COPY is a directory, all files are copied into that directory. The first pathname may only specify files in the working directory.

```
DEL <pathname>
```

If the pathname is a directory, all the files in that directory are deleted. Note: The prompt "Are you sure (Y\N)?" will be displayed if you try to delete a path. Y to complete the command, or type N for the command to abort.

DIR <pathname>
Displays the directory for a specific path.

TYPE <pathname>
You must specify a file in a path for this command. MS-DOS will display the file on your screen in response to the TYPE pathname command.

3.7.4 Displaying Your Working Directory

All commands are executed while you are in your working directory. You can find out the name of the directory you are in by issuing the MS-DOS command CHDIR (Change Directory) with no options. For example, if your current directory is \USER\JOE, when you type:

CHDIR<RETURN>

you will see:

A:\USER\JOE

This is your current drive designation plus the working directory (\USER\JOE).

If you now want to see what is in the \USER\JOE directory, you can issue the MS-DOS command DIR. The following is an example of the display you might receive from the DIR command for a subdirectory:

Volume in drive A has no ID
Directory of A:\USER\JOE

.	<DIR>	8-09-82	10:09a
..	<DIR>	8-09-82	10:09a
TEXT	<DIR>	8-09-82	10:09a
FILE1 COM	5243	8-04-82	9:30a
4 File(s)	8376320 bytes free		

A volume ID for this disk was not assigned when the disk was formatted. Note that MS-DOS lists both files and directories in this output. As you can see, Joe has another directory in this tree structure named TEXT. The '.' indicates the working directory \USER\JOE, and the '..' is the shorthand notation for the parent directory \USER. FILE1.COM is a file in the \USER\JOE directory. All of these directories and files reside on the disk in drive A.

Because files and directories are listed together (see previous display), MS-DOS does not allow you to give a subdirectory the same name as a file in that directory. For

example, if you have a path \BIN\USER\JOE where JOE is a subdirectory, you cannot create a file in the USER directory named JOE.

3.7.5 Creating A Directory

To create a subdirectory in your working directory, use the MKDIR (Make Directory) command. For example, to create a new directory named "NEWDIR" under your working directory, simply type:

```
MKDIR NEWDIR
```

After this command has been executed by MS-DOS, a new directory will exist in your tree structure under your working directory. You can also make directories anywhere in the tree structure by specifying MKDIR and then a pathname. MS-DOS will automatically create the . and .. entries in the new directory.

To put files in the new directory, use the MS-DOS line editor, EDLIN. Chapter 7, The Line Editor (EDLIN), describes how to use EDLIN to create and save files.

3.7.6 How To Change Your Working Directory

Changing from your working directory to another directory is very easy in MS-DOS. Simply issue the CHDIR (Change Directory) command and supply a pathname. For example:

```
A:CHDIR \USER
```

changes the working directory from \USER\JOE to \USER. You can specify any pathname after the command to "travel" to different branches and leaves of the directory tree. The command "CHDIR .." will always put you in the parent directory of your working directory.

3.7.7 How To Remove A Directory

To delete a directory in the tree structure, use the MS-DOS RMDIR (Remove Directory) command. For example, to remove the directory NEWDIR from the working directory, type:

```
RMDIR NEWDIR
```

Note that the directory NEWDIR must be empty except for the prevent you from accidentally deleting files and

directories. You can remove any directory by specifying its pathname. To remove the \BIN\USER\JOE directory, make sure that it has only the . and .. entries, then type:

```
RMDIR \BIN\USER\JOE
```

To remove all the files in a directory (except for the . and .. entries), type DEL and then the pathname of the directory. For example, to delete all files in the \BIN\USER\SUE directory, type:

```
DEL \BIN\USER\SUE
```

You cannot delete the . and .. entries. They are created by MS-DOS as part of the hierarchical directory structure.

3.7.8 How To Rename A Directory

To rename a directory, use the RENDIR (Rename Directory) command. For example, to change the name of the JOE directory to BOB, you must first be in the parent directory of JOE, which is USER. To do this, type

```
CD \USER
```

Then you can rename the directory by typing:

```
RENDIR JOE BOB
```

Summary of Commands in This Chapter

COMMAND	PURPOSE	SYNTAX
COPY	Copies files	COPY pathname [pathname]
PATH	Sets MS-DOS search path	PATH [pathname]
CHDIR	Displays working directory; changes directories	CHDIR [pathname]
MKDIR	Makes a new directory	MKDIR [pathname]
RMDIR	Removes a directory	RMDIR [pathname]
RENDIR	Rename a directory	RENDIR directory name

In the next chapter, you will learn about MS-DOS commands.

CHAPTER 4
LEARNING ABOUT COMMANDS

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4.1 INTRODUCTION

Commands are a way of communicating with the computer. By entering MS-DOS commands at your terminal, you can ask the system to perform useful tasks. There are MS-DOS commands that:

Compare, copy, display, delete, and rename files

Copy and format disks

Execute system programs such as EDLIN, as well as your own programs

Analyze and list directories

Enter date, time, and remarks

Set various printer and screen options

Copy MS-DOS system files to another disk

Request MS-DOS to wait for a specific period of time

4.2 TYPES OF MS-DOS COMMANDS

There are two types of MS-DOS commands:

Internal commands

External commands

Internal commands are the simplest, most commonly used commands. You cannot see these commands when you do a directory listing on your MS-DOS disk; they are part of the command processor. When you type these commands, they execute immediately. The following internal commands are described in Chapter 5:

BREAK	DEL (ERASE)	MKDIR (MD)	SET
CHDIR (CD)	DIR	PATH	SHIFT
CLS	ECHO	PAUSE	TIME
COPY	EXIT	PROMPT	TYPE
CTTY	FOR	REM	VER
DATE	GOTO	REN (RENAME)	VERIFY
	IF	RMDIR (RD)	VOL

External commands reside on disks as program files. They must be read from disk before they can execute. If the disk containing the command is not in the drive, MS-DOS will not be able to find and execute the command.

Any filename with a filename extension of .COM, .EXE or .BAT is considered an external command. For example, programs such as FORMAT.COM and COMP.COM are external commands. Because all external commands reside on disk, you can create commands and add them to the system. Programs that you create with most languages (including assembly language) will be .EXE (executable) files.

When you enter an external command, do not include its filename extension. The following external commands are described in Chapter 5:

BACKUP	MEMTEST
BUFFER	MORE
CHKDSK	PRINT
DISKCOPY	RECOVER
EXE2BIN	RENDIR
FIND	SHIPZONE
FORMAT	SORT
FUNKEY	SYS
INSTALL	

4.3 COMMAND OPTIONS

Options can be included in your MS-DOS commands to specify additional information to the system. If you do not include some options, MS-DOS provides a default value. Refer to individual command descriptions in Chapter 5 for the default values.

The following is the format of all MS-DOS commands:

Command [options...]
where:

d: Refers to disk drive designation.

filename Refers to any valid name for a disk file, including an optional filename extension. The filename option does not refer to a device or to a disk drive designation.

.ext	Refers to an optional filename extension consisting of a period and 1-3 characters. When used, filename extensions immediately follow filenames.
filespec	Refers to an optional drive designation, a filename, and an optional three letter filename extension in the following format: [<d:>]<filename>[.<ext>]
pathname	Refers to a pathname or filename in the following format: [<directory>]\[<directory...>]\[<filename>]
switches	Switches are options that control MS-DOS commands. They are preceded by a forward slash (for example, /P).
arguments	Provide more information to MS-DOS commands. You usually choose between arguments; for example, ON or OFF.

4.4 INFORMATION COMMON TO ALL MS-DOS COMMANDS

The following information applies to all MS-DOS commands:

1. Commands are usually followed by one or more options.
2. Commands and options may be entered in uppercase or lowercase, or a combination of keys.
3. Commands and options must be separated by delimiters. Because they are easiest, you will usually use the space and comma as delimiters. For example:

```
DEL MYFILE.OLD NEWFILE.TXT  
RENAME,THISFILE THATFILE
```

You can also use the semicolon (;), the equal sign (=), or the tab key as delimiters in MS-DOS commands.

In this manual, we will use a space as the delimiter in commands.

4. Do not separate a file specification with delimiters, since the colon and the period already serve as delimiters.
5. When instructions say "Press any key," you can press any alpha (A-Z) or numeric (0-9) key.
6. You must include the filename extension when referring to a file that already has a filename extension.
7. You can abort commands when they are running by pressing <CONTROL-C>.
8. Commands take effect only after you have pressed the <RETURN> key.
9. Wild cards (global filename characters) and device names (for example, PRN or CON) are not allowed in the names of any commands.
10. When commands produce a large amount of output on the screen, the display will automatically scroll to the next screen. You can press <CONTROL-S> to suspend the display. Press any key to resume the display on the screen.
11. MS-DOS editing and function keys can be used when entering commands. Refer to Chapter 6, MS-DOS Editing and Function Keys, for a complete description of these keys.
12. The prompt from the command processor is the default drive designation plus a colon; for example, A:.
13. Disk drives will be referred to as source drives and destination drives. A source drive is the drive you will be transferring information from. A destination drive is the drive you will be transferring information to.

4.5 BATCH PROCESSING

Often you may find yourself typing the same sequence of commands over and over to perform some commonly used task. With MS-DOS, you can put the command sequence into a special file called a batch file, and execute the entire sequence simply by typing the name of the batch file. "Batches" of your commands in such files are processed as if they were typed at a terminal. Each batch file must be named with the .BAT extension, and is executed by typing the filename without its extension.

You can create a batch file by using the Line Editor (EDLIN) or by typing the COPY command. Refer to the How to Create an AUTOEXEC.BAT File section later in this chapter for more information on using the COPY command to create a batch file.

Two MS-DOS commands are available for use expressly in batch files: REM and PAUSE. REM permits you to include remarks and comments in your batch files without these remarks being executed as commands. PAUSE prompts you with an optional message and permits you to either continue or abort the batch process at a given point. REM and PAUSE are described in detail in Chapter 5.

Batch processing is useful if you want to execute several MS-DOS commands with one batch command, such as when you format and check a new disk. For example, a batch file for this purpose might look like this:

```
1: REM This is a file to check new disks
2: REM It is named NEWDISK.BAT
3: PAUSE Insert new disk in drive B:
4: FORMAT B:
5: DIR B:
6: CHDKSK B:
```

To execute this .BAT file, simply type the filename without the .BAT extension:

NEWDISK

The result is the same as if each of the lines in the .BAT file was entered at the terminal as individual commands.

Figure 6 illustrates the 3 steps used to write, save, and execute an MS-DOS batch file.

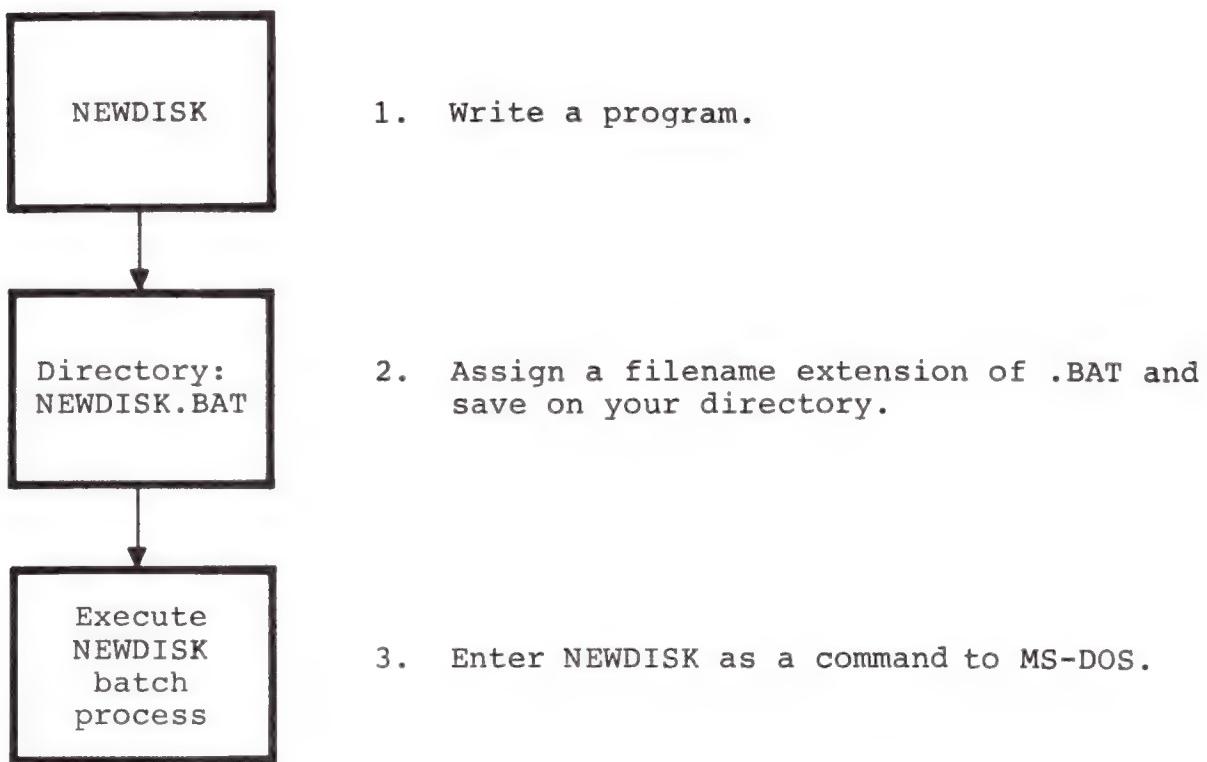


Figure 6. MS-DOS Batch File Steps

The following list contains information that you should read before you execute a batch process with MS-DOS:

1. Do not enter the filename BATCH (unless the name of the file you want to execute is BATCH.BAT).
2. Only the filename should be entered to execute the batch file. Do not enter the filename extension.
3. The commands in the file named <filename>.BAT are executed.
4. If you press <CONTROL-C> while in batch mode, this prompt appears:

Terminate batch job (Y/N)?

If you press Y, the remainder of the commands in the batch file are ignored and the system prompt appears.

If you press N, only the current command ends and batch processing continues with the next command in the file.

5. If you remove the disk containing a batch file being executed, MS-DOS prompts you to insert it again before the next command can be read.
6. The last command in a batch file may be the name of another batch file. This allows you to call one batch file from another when the first is finished.

4.6 THE AUTOEXEC.BAT FILE

As discussed in Chapter 2, an AUTOEXEC.BAT file allows you to automatically execute programs when you start MS-DOS. Automatic Program Execution is useful when you want to run a specific package (for example, Microsoft Multiplan) under MS-DOS, and when you want MS-DOS to execute a batch program automatically each time you start the system. You can avoid loading two separate disks to perform either of these tasks by using an AUTOEXEC.BAT file.

When you start MS-DOS, the command processor searches the MS-DOS disk for a file named AUTOEXEC.BAT. The AUTOEXEC.BAT file is a batch file that is automatically executed each time you start the system.

If MS-DOS finds the AUTOEXEC.BAT file, the file is immediately executed by the command processor and the date and time prompts are bypassed.

If MS-DOS does not find an AUTOEXEC.BAT file when you first load the MS-DOS disk, then the date and time prompts will be issued. Figure 7 illustrates how MS-DOS uses the AUTOEXEC.BAT file.

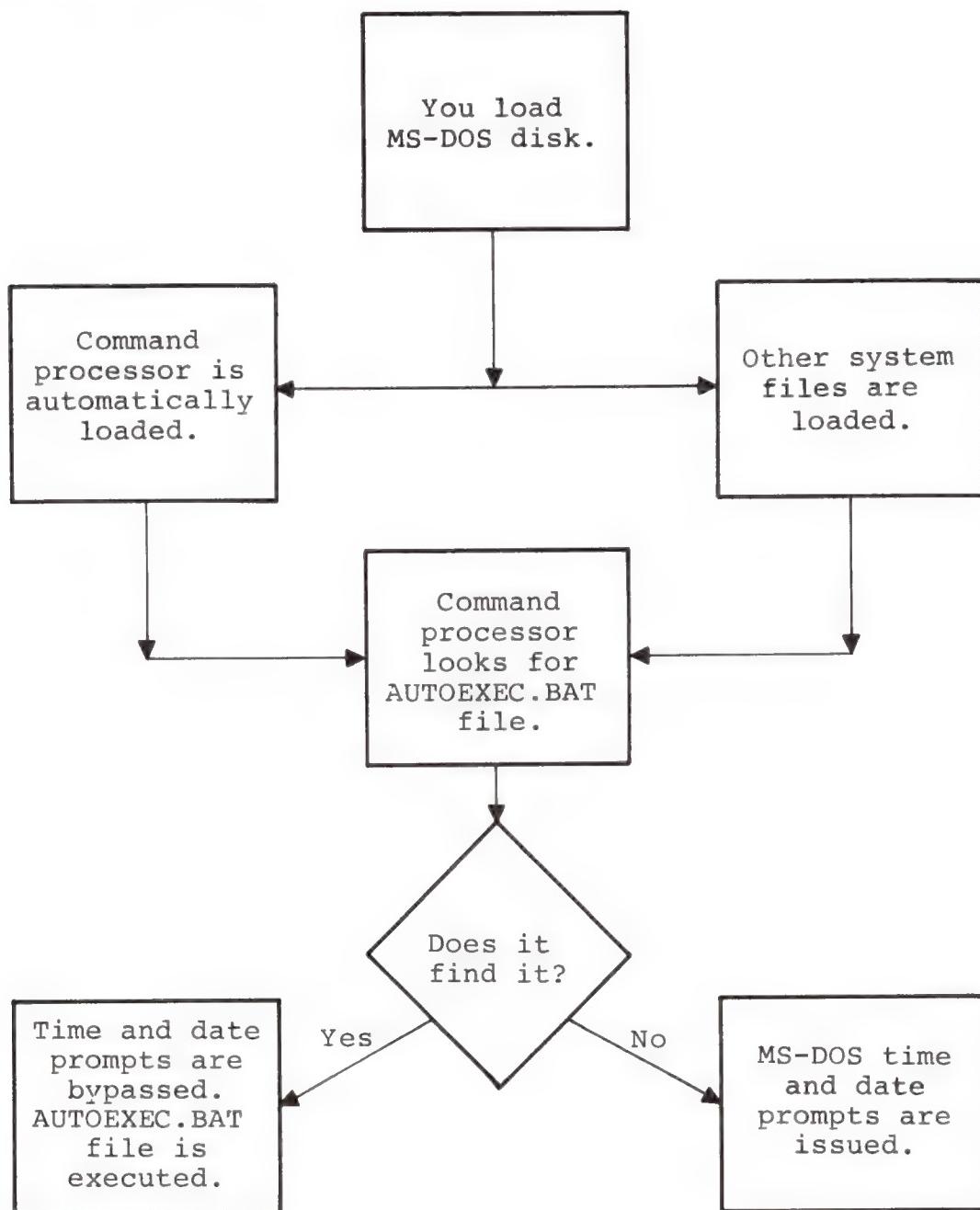


Figure 7. How MS-DOS Uses the AUTOEXEC.BAT File

4.6.1 How To Create An AUTOEXEC.BAT File

If, for example, you wanted to automatically load BASIC and run a program called MENU each time you started MS-DOS, you could create an AUTOEXEC.BAT file as follows:

1. Type:

```
COPY CON: AUTOEXEC.BAT
```

This statement tells MS-DOS to copy the information from the console (keyboard) into the AUTOEXEC.BAT file. Note that the AUTOEXEC.BAT file must be created in the root directory of your MS-DOS disk.

2. Now type:

```
BASIC86 MENU
```

This statement goes into the AUTOEXEC.BAT file. It tells MS-DOS to load BASIC and run the MENU program whenever MS-DOS is started.

3. Press the <CONTROL-Z> key; then press the <RETURN> key to put the command BASIC86 MENU in the AUTOEXEC.BAT file.
4. The MENU program will now run automatically whenever you start MS-DOS.

To run your own BASIC program, enter the name of your program in place of MENU in the second line of the example. You can enter any MS-DOS command or series of commands in the AUTOEXEC.BAT file.

NOTE

Remember that if you use an AUTOEXEC.BAT file, MS-DOS will not prompt you for a current date and time unless you include the DATE and TIME commands in the AUTOEXEC.BAT file. It is strongly recommended that you include these two commands in your AUTOEXEC.BAT file, since MS-DOS uses this information to keep your directory current.

4.7 CREATING A .BAT FILE WITH REPLACEABLE PARAMETERS

There may be times when you want to create an application program and run it with different sets of data. These data may be stored in various MS-DOS files.

When used in MS-DOS commands, a parameter is an option that you define. With MS-DOS, you can create a batch (.BAT) file with dummy (replaceable) parameters. These parameters, named %0-%9, can be replaced by values supplied when the batch file executes.

For example, when you type the command line COPY CON MYFILE.BAT, the next lines you type are copied from the console to a file named MYFILE.BAT on the default drive:

```
A:COPY CON MYFILE.BAT
COPY %1.MAC %2.MAC
TYPE %2.PRN
TYPE %0.BAT
```

Now, press <CONTROL-Z> and then press <RETURN>. MS-DOS responds with this message:

```
1 File(s) copied
A:_
```

The file MYFILE.BAT, which consists of three commands, now resides on the disk in the default drive.

The dummy parameters %1 and %2 are replaced sequentially by the parameters you supply when you execute the file. The dummy parameter %0 is always replaced by the drive designator, if specified, and the filename of the batch file (for example, MYFILE).

NOTES:

1. Up to 10 dummy parameters (%0-%9) can be specified. Refer to the MS-DOS command SHIFT in Chapter 5 if you wish to specify more than 10 parameters.
2. If you use the percent sign as part of a filename within a batch file, you must type it twice. For example, to specify the file ABC%.EXE, you must type it as ABC%%.EXE in the batch file.

4.7.1 Executing A .BAT File

To execute the batch file MYFILE.BAT and to specify the parameters that will replace the dummy parameters, you must enter the batch filename (without its extension) followed by the parameters you want MS-DOS to substitute for %1, %2, etc.

Remember that the file MYFILE.BAT consists of 3 lines:

```
COPY %1.MAC %2.MAC  
TYPE %2.PRN  
TYPE %0.BAT
```

To execute the MYFILE batch process, type:

```
MYFILE A:PROG1 B:PROG2
```

MYFILE is substituted for %0, A:PROG1 for %1, and B:PROG2 for %2.

The result is the same as if you had typed each of the commands in MYFILE with their parameters, as follows:

```
COPY A:PROG1.MAC B:PROG2.MAC  
TYPE B:PROG2.PRN  
TYPE MYFILE.BAT
```

The following table illustrates how MS-DOS replaces each of the above parameters:

BATCH FILENAME	PARAMETER1 (%0) (MYFILE)	PARAMETER2 (%1) (PROG1)	PARAMETER3 (%2) (PROG2)
MYFILE	MYFILE.BAT	PROG1.MAC	PROG2.MAC PROG2.PRN

Remember that the dummy parameter %0 is always replaced by the drive designator (if specified) and the filename of the batch file.

4.8 INPUT AND OUTPUT

MS-DOS always assumes that input comes from the keyboard and output goes to the terminal screen. However, the flow of command input and output can be redirected. Input can come from a file rather than a terminal keyboard, and output can go to a file or to a line printer instead of to the terminal. In addition, "pipes" can be created that allow output from one command to become the input to another. Redirection and pipes are discussed in the next sections.

4.8.1 Redirecting Your Output

Most commands produce output that is sent to your terminal. You can send this information to a file by using a greater-than sign (>) in your command. For example, the command

```
DIR
```

displays a directory listing of the disk in the default drive on the terminal screen. The same command can send this output to a file named MYFILES by designating the output file on the command line:

```
DIR >MYFILES
```

If the file MYFILES does not already exist, MS-DOS creates it and stores your directory listing in it. If MYFILES already exists, MS-DOS overwrites what is in the file with the new data.

If you want to append your directory or a file to another file (instead of replacing the entire file), two greater-than signs (>>) can be used to tell MS-DOS to append the output of the command (such as a directory listing) to the end of a specified file. The command

```
DIR >>MYFILES
```

appends your directory listing to a currently existing file named MYFILES. If MYFILES does not exist, it is created.

It is often useful to have input for a command come from a file rather than from a terminal. This is possible in MS-DOS by using a less-than sign (<) in your command. For example, the command

```
SORT <NAMES> LIST1
```

sorts the file NAMES and sends the sorted output to a file named LIST1.

4.8.2 Filters

A filter is a command that reads your input, transforms it in some way, and then outputs it, usually to your terminal or to a file. In this way, the data is said to have been "filtered" by the program. Since filters can be put together in many different ways, a few filters can take the place of a large number of specific commands.

MS-DOS filters include FIND, MORE, and SORT. Their functions

are described below:

FIND	Searches for a constant string of text in a file
MORE	Takes standard terminal output and displays it, one screen at a time
SORT	Sorts text

You can see how these filters are used in the next section.

4.8.3 Command Piping

If you want to give more than one command to the system at a time, you can "pipe" commands to MS-DOS. For example, you may occasionally need to have the output of one program sent as the input to another program. A typical case would be a program that produces output in columns. It could be desirable to have this columnar output sorted.

Piping is done by separating commands with the pipe separator, which is the vertical bar symbol (|). For example, the command

```
DIR | SORT
```

will give you an alphabetically sorted listing of your directory. The vertical bar causes all output generated by the left side of the bar to be sent to the right side of the bar for processing.

Piping can also be used when you want to output to a file. If you want your directory sorted and sent to a new file (for example, DIREC.FIL), you could type:

```
DIR | SORT >DIREC.FIL
```

MS-DOS will create a file named DIREC.FIL on your default drive. DIREC.FIL contains a sorted listing of the directory on the default drive, since no other drive was specified in the command. To specify a drive other than the default drive, type:

```
DIR | SORT >B:DIREC.FIL
```

This sends the sorted data to a file named DIREC.FIL on drive B.

A pipeline may consist of more than two commands. For example,

DIR | SORT | MORE

will sort your directory, show it to you one screen at a time, and put "--MORE--" at the bottom of your screen when there is more output to be seen.

You will find many uses for piping commands and filters.

Summary of Commands in This Chapter

COMMAND	PURPOSE	SYNTAX
REM	Adds comment line for batch files	REM [remark]
PAUSE	Suspends execution of a batch file	PAUSE [comment]
FIND	Searches for string of text	FIND string [filename]
MORE	Pages through a file 23 lines at a time	MORE
SORT	Sorts text	SORT

You will find more information on using these filters in the next chapter, MS-DOS Commands.

CHAPTER 5
MS-DOS COMMANDS

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5.1 COMMAND FORMATS

The following notation indicates how you should format MS-DOS commands:

1. You must enter any words shown in capital letters. These words are called keywords and must be entered exactly as shown. You can enter these keywords in any combination of upper/lowercase; MS-DOS will convert all keywords to uppercase.
2. You supply the text for any items enclosed in angle brackets (< >). For example, you should enter the name of your file when <filename> is shown in the format.
3. Items in square brackets ([]) are optional. If you wish to include optional information, do not include the square brackets, only the information within the brackets.
4. An ellipsis (...) indicates that you may repeat an item as many times as you want.
5. You must include all punctuation where shown (with the exception of square brackets), such as commas, equal signs, question marks, colons, or slashes.

5.2 MS-DOS COMMANDS

The following MS-DOS commands are described in this chapter. Note that synonyms for commands are enclosed in parentheses.

BACKUP	Makes backup copies of hard disk files
BREAK	Sets CONTROL-C check
BUFFER	Clears FLASH PRINT buffer
CHDIR	Changes directories; prints working directory (CD)
CHKDSK	Scans the directory of the default or designated drive and checks for consistency
CLS	Clears screen
COPY	Copies file(s) specified
CTTY	Changes console TTY

DATE Displays and sets date
DEL Deletes file(s) specified (ERASE)
DIR Lists requested directory entries
DISKCOPY Copies disks
EXE2BIN Converts executable files to binary format
EXIT Exits command and returns to lower level
FIND Searches for a constant string of text
FUNKEY Defines editing keys
FORMAT Formats a disk to receive MS-DOS file
INSTALL Copies a file to hidden IO.SYS file
MEMTEST Tests memory
MKDIR Makes a directory (MD)
MORE Displays output one screen at a time
PATH Sets a command search path
PRINT Background print feature
PROMPT Designates command prompt
RECOVER Recovers a bad disk
REM Displays a comment in a batch file
REN Renames first file as second file (RENAME)
RENDIR Renames a directory
RMDIR Removes a directory (RD)
SET Sets one string value to another
SHIPZONE Moves the hard disk head to the shipping position
SORT Sorts data alphabetically, forward or backward

SYS Transfers MS-DOS system files from drive A: to the drive specified
TIME Displays and sets time
TYPE Displays the contents of file specified
VER Prints MS-DOS version number
VERIFY Verifies writes to disk
VOL Prints volume identification number

Batch Commands (Command extensions)

ECHO Turns batch file echo feature on/off
FOR Batch command extension
GOTO Batch command extension
IF Batch command extension
PAUSE Pauses for input in a batch file
SHIFT Increases number of replaceable parameters in batch process

NAME	TYPE
BACKUP	External

PURPOSE
Makes backup copies of hard disk files and produces an index of backed up files.

SYNTAX
BACKUP d: [d:] [/I] [/N]

COMMENTS**NOTE**

When you use the BACKUP command to back up a hard disk, all your files must have different names.

If you are backing up your hard disk for the first time, BACKUP will make backup copies of every file on the disk. After you have backed up your disk for the first time, BACKUP copies only those files that have been changed since the last backup operation.

The first drive specified is the disk drive to be backup up (source); the second drive is the disk on which to make the copies (destination). For example, the following command will back up drive C onto drive B:

BACKUP C: B:

The destination drive specifier may be omitted if it is the default drive. For example

BACKUP C:

backs up drive C onto the default drive.

BACKUP also creates an index of the files that were backed up. The index lists all files and also the name of the backup disk on which each file is located, helping you to find the backup disk for any file.

This file is named INDEX and it is placed on the root directory of the disk being backed up.

An example of an INDEX file is shown below. Note that each directory is listed along with all sub-directories and files in that directory. For each file, the volume label of the backup disk is listed to make it easy to find a file.

Directory Name		Date of last update	Time of last update	Size (in bytes)	Volume label of backup disk
\					
BIN		01-01-80	00:00:00		
DOCUMENT		01-01-80	00:00:00		
AUTOEXEC BAT		06-30-83	15:59:48	34	DISK-1
COMMAND COM		03-15-83	23:09:08	15480	DISK-1
INDEX		09-14-83	07:52:18	15665	DISK-1
\BIN					
ASM COM		01-05-83	17:54:22	8138	DISK-1
AUTOEXEC BAT		06-30-83	15:58:46	33	DISK-1
BACKUP COM		03-12-83	13:25:54	1991	DISK-1
BASIC86 COM		11-10-82	13:54:28	31360	DISK-1
		.			
		.			
		.			
\DOCUMENT					
COBOL		06-29-83	13:22:54		
COMMANDS		06-29-83	13:23:04		
CPU		07-30-83	12:37:06		
CPUSPRT		08-30-83	10:35:08		
\DOCUMENT\COBOL					
COB-REF WS		07-19-83	12:01:20	388096	DISK-1
COB-UG WS		07-28-83	16:24:52	197504	DISK-2
\DOCUMENT\COMMANDS					
ASM DOC		03-22-83	22:06:38	23295	DISK-2
HEX2BIN DOC		07-02-82	12:00:02	2048	DISK-2
TRANS DOC		04-20-82	18:11:44	3398	DISK-2
\DOCUMENT\CPU					
CONTENTS CPU		07-30-83	12:33:04	768	DISK-2
OPERATE CPU		07-30-83	12:32:42	5760	DISK-2
S100PINS CPU		07-30-83	12:32:48	1152	DISK-2
TECHDESC CPU		07-30-83	12:32:54	10496	DISK-2
THEORY CPU		07-30-83	12:33:02	19968	DISK-2
TIMING CPU		07-30-83	12:32:46	2432	DISK-2
\DOCUMENT\CPUSPRT					
3INTCONT WS		08-24-83	16:07:00	56994	DISK-3
4TIMER WS		08-24-83	16:07:26	28280	DISK-3
5SERIAL WS		08-24-83	16:07:40	13890	DISK-3

If you want to create an index only without copying any files, use the /I switch. For example, to make an index for drive C without doing any backup copying, type:

```
BACKUP C: /I
```

The /N switch is used to see which files have changed but to do no copying. A file called INDEX.NEW is created in the root directory of the file being backup up. In this file, every file which has changed since the last bckup is marked with an asterisk (*).

NAME	TYPE
------	------

BREAK	Internal
-------	----------

PURPOSE

Sets CONTROL-C check.

SYNTAX

BREAK ON|OFF

COMMENTS

If you are running an application program that uses CONTROL-C function keys, you will want to turn off the MS-DOS CONTROL-C function so that when you press <CONTROL-C> you affect your program and not the operating system. Specify BREAK OFF to turn off CONTROL-C and BREAK ON when you have finished running your application program and are using MS-DOS.

NAME	TYPE
BUFFER	External

PURPOSE

Displays FLASH PRINT buffer size and allows you to clear data from FLASH PRINT buffer.

SYNTAX

BUFFER

COMMENTS

If FLASH PRINT is installed on your system, the BUFFER command lets you know the size of the FLASH PRINT buffer and how much data it contains at the present time. It also asks you if you want to clear the buffer. (FLASH PRINT is described in Chapter 11.)

After you type:

BUFFER

you see a message such as the one shown below:

Seattle Computer FLASH PRINT program utility. Ver 1.0
Buffer size is 10249 characters. There are now 105
characters left to be printed.

Clear buffer? (Y/N)

NAME	TYPE
CHDIR (CHANGE DIRECTORY)	Internal

SYNONYM
CD

PURPOSE
Changes directory to a different path;
displays current (working) directory.

SYNTAX
CHDIR [pathname]

COMMENTS
If your working directory is \BIN\USER\JOE and
you want to change your path to another
directory (such as \BIN\USER\JOE\FORMS), type:

CHDIR \BIN\USER\JOE\FORMS

and MS-DOS will put you in the new directory.
A shorthand notation is also available with
this command:

CHDIR ..

This command will always put you in the parent
directory of your working directory.

CHDIR used without a pathname displays your
working directory. If your working directory
is \BIN\USER\JOE on drive B, and you type CHDIR
<RETURN>, MS-DOS will display:

B: \BIN\USER\JOE

This command is useful if you forget the name
of your working directory.

NAME	TYPE
CHKDSK (CHECK DISK)	External

PURPOSE

Scans the directory of the specified disk drive and checks it for consistency.

SYNTAX

CHKDSK [d:] <filespec> [/F] [/V]

COMMENTS

CHKDSK should be run occasionally on each disk to check for errors in the directory. If any errors are found, CHKDSK will display error messages, if any, and then a status report.

A sample status report follows:

```
160256 bytes total disk space
 8192 bytes in 2 hidden files
   512 bytes in 2 directories
 30720 bytes in 8 user files
121344 bytes available on disk

       65536 bytes total memory
      53152 bytes free
```

CHKDSK will not correct the errors found in your directory unless you specify the /F (fix) switch. Typing /V causes CHKDSK to display messages while it is running.

You can redirect the output from CHKDSK to a file. Simply type:

```
CHKDSK A:>filename
```

The errors will be sent to the filename specified. Do not use the /F switch if you redirect CHKDSK output.

The following errors will be corrected automatically if you specify the /F switch:

Invalid drive specification

Invalid parameter

Invalid sub-directory entry

Cannot CHDIR to <filename>

Tree past this point not processed
First cluster number is invalid
entry truncated

Allocation error, size adjusted

Has invalid cluster, file truncated

Disk error reading FAT

Disk error writing FAT

<filename> contains
non-contiguous blocks

All specified file(s) are contiguous

You must correct the following errors returned
by CHKDSK, even if you specified the /F switch:

Incorrect DOS version

You cannot run CHKDSK on versions of MS-DOS
that are not 2.0 or higher.

Insufficient memory

Processing cannot continue

There is not enough memory in your machine
to process CHKDSK for this disk. You must
obtain more memory to run CHKDSK.

Errors found, F parameter not specified

Corrections will not be written to disk

You must specify the /F switch if you want
the errors corrected by CHKDSK.

Invalid current directory

Processing cannot continue

Restart the system and re-run CHKDSK.

Cannot CHDIR to root

Processing cannot continue

The disk you are checking is bad. Try
restarting MS-DOS and RECOVER the disk.

<filename> is cross linked on cluster

Make a copy of the file you want to keep,
and then delete both files that are cross
linked.

X lost clusters found in y chains

Convert lost chains to files (Y/N)?

If you respond Y to this prompt, CHKDSK
will create a directory entry and a file

for you to resolve this problem (files created by CHKDSK are named FILEnnnnnnnn). CHKDSK will then display:

X bytes disk space freed

If you respond N to this prompt and have not specified the /F switch, CHKDSK frees the clusters and displays:

X bytes disk space would be freed

Probable non-DOS disk
Continue (Y/N)?

The disk you are using is a non-DOS disk.
You must indicate whether or not you want
CHKDSK to continue processing.

Insufficient room in root directory
Erase files in root and repeat CHKDSK
CHKDSK cannot process until you delete
files in the root directory.

Unrecoverable error in directory
Convert directory to file (Y/N)?
If you respond Y to this prompt, CHKDSK
will convert the bad directory into a file.
You can then fix the directory yourself or
delete it.

NAME	TYPE
CLS	Internal

PURPOSE
Clears the terminal screen.

SYNTAX
CLS

COMMENTS
The CLS command causes MS-DOS to send the ANSI escape sequence ESC[2J (which clears your screen) to your console.

NAME	TYPE
COPY	Internal

PURPOSE

Copies one or more files to another disk. If you prefer, you can give the copies different names. This command can also copy files on the same disk.

SYNTAX

```
COPY <filespec> [filespec] [pathname]  
[pathname] [/V]
```

COMMENTS

If the second filespec option is not given, the copy will be on the default drive and will have the same name as the original file (first filespec option). If the first filespec is on the default drive and the second filespec is not specified, the COPY will be aborted. (Copying files to themselves is not allowed.) MS-DOS will return the error message:

```
File cannot be copied onto itself  
0 File(s) copied
```

The second option may take three forms:

1. If the second option is a drive designation (d:) only, the original file is copied with the original filename to the designated drive.
2. If the second option is a filename only, the original file is copied to a file on the default drive with the filename specified.
3. If the second option is a full filespec, the original file is copied to a file on the default drive with the filename specified.

The /V switch causes MS-DOS to verify that the sectors written on the destination disk are recorded properly. Although there are rarely recording errors when you run COPY, you can verify that critical data has been correctly recorded. This option causes the COPY command to run more slowly because MS-DOS must check each entry recorded on the disk.

The COPY command also allows file concatenation (joining) while copying. Concatenation is accomplished by simply listing any number of files as options to COPY, separated by "+".

For example,

```
COPY A.XYZ + B.COM + B:C.TXT BIGFILE.CRP
```

This command concatenates files named A.XYZ, B.COM, and B:C.TXT and places them in the file on the default drive called BIGFILE.CRP.

To combine several files using wild cards into one file, you could type:

```
COPY *.LST COMBIN.PRN
```

This command would take all files with a filename extension of .LST and combine them into a file named COMBIN.PRN.

In the following example, for each file found matching *.LST, that file is combined with the corresponding .REF file. The result is a file with the same filename but with the extension .PRN. Thus, FILE1.LST will be combined with FILE1.REF to form FILE1.PRN; then XYZ.LST with XYZ.REF to form XYZ.PRN; and so on.

```
COPY *.LST + *.REF *.PRN
```

The following COPY command combines all files matching *.LST, then all files matching *.REF, into one file named COMBIN.PRN:

```
COPY *.LST + *.REF COMBIN.PRN
```

Do not enter a concatenation COPY command where one of the source filenames has the same extension as the destination. For example, the following command is an error if ALL.LST already exists:

```
COPY *.LST ALL.LST
```

The error would not be detected, however, until ALL.LST is appended. At this point it could have already been destroyed.

COPY compares the filename of the input file with the filename of the destination. If they are the same, that one input file is skipped, and the error message "Content of destination lost before copy" is printed. Further concatenation proceeds normally. This allows "summing" files, as in this example:

```
COPY ALL.LST + *.LST
```

This command appends all *.LST files, except ALL.LST itself, to ALL.LST. This command will not produce an error message and is the correct way to append files using the COPY command.

NAME	TYPE
CTTY	Internal

PURPOSE

Allows you to change the device from which you issue commands (TTY represents the console).

SYNTAX

CTTY /<device>

COMMENTS

The <device> is the device from which you are giving commands to MS-DOS. This command is useful if you want to change the device on which you are working. The command

CTTY /AUX

moves all command I\O (input\output) from the current device (the console) to the AUX port, such as a printer. The command

CTTY /CON

moves I\O back to the original device (here, the console). Refer to the Illegal Filenames section of Chapter 3, More About Files, for a list of valid device names to use with the CTTY command.

NAME	TYPE
DATE	Internal

PURPOSE

Enter or change the date known to the system. This date will be recorded in the directory for any files you create or alter.

You can change the date from your terminal or from a batch file. (MS-DOS does not display a prompt for the date if you use an AUTOEXEC.BAT file, so you may want to include a DATE command in that file.)

SYNTAX

DATE [<mm>-<dd>-<yy>]

COMMENTS

If you type DATE, DATE will respond with the message:

Current date is <mm>-<dd>-<yy>
Enter new date:__

Press <RETURN> if you do not want to change the date shown.

You can also type a particular date after the DATE command, as in:

DATE 3-9-81

In this case, you do not have to answer the "Enter new date:" prompt.

The new date must be entered using numerals only; letters are not permitted. The allowed options are:

<mm> = 1-12
<dd> = 1-31
<yy> = 80-99 or 1980-2099

The date, month, and year entries may be separated by hyphens (-) or slashes (/). MS-DOS is programmed to change months and years correctly, whether the month has 31, 30, 29, or 28 days. MS-DOS handles leap years, too.

If the options or separators are not valid,
DATE displays the message:

Invalid date
Enter new date:_

DATE then waits for you to enter a valid date.

NAME	TYPE
DEL (DELETE)	Internal
SYNONYM	
ERASE	
PURPOSE	Deletes all files with the designated filespec.
SYNTAX	DEL [filespec] [pathname]
COMMENTS	If the filespec is <code>*.*</code> , the prompt "Are you sure?" appears. If a "Y" or "y" is typed as a response, then all files are deleted as requested. You can also type ERASE for the DELETE command.

NAME	TYPE
DIR (DIRECTORY)	Internal

SYNTAX
DIR [filespec] [pathname] [/P] [/W]

PURPOSE
Lists the files in a directory.

COMMENTS

If you just type DIR, all directory entries on the default drive are listed. If only the drive specification is given (DIR d:), all entries on the disk in the specified drive are listed. If only a filename is entered with no extension (DIR filename), then all files with the designated filename on the disk in the default drive are listed. If you designate a file specification (for example, DIR d:filename.ext), all files with the filename specified on the disk in the drive specified are listed. In all cases, files are listed with their size in bytes and with the time and date of their last modification.

The wild card characters ? and * (question mark and asterisk) may be used in the filename option. Note that for your convenience the following DIR commands are equivalent:

COMMAND	EQUIVALENT
DIR	DIR *.*
DIR FILENAME	DIR FILENAME.*
DIR .EXT	DIR *.EXT
DIR .	DIR *.

Two switches may be specified with DIR. The /P switch selects Page Mode. With /P, display of the directory pauses after the screen is filled. To resume display of output, press any key.

The /W switch selects Wide Display. With /W, only filenames are displayed, without other file information. Files are displayed five per line.

NAME	TYPE
DISKCOPY	External

PURPOSE

Copies the contents of the disk in the source drive to the disk in the destination drive.

SYNTAX

DISKCOPY [d:] [d:]

COMMENTS

The first option you specify is the source drive. The second option is the destination drive.

The disk in the destination drive must be formatted prior to using DISKCOPY.

You can specify the same drives or you may specify different drives. If the drives designated are the same, a single-drive copy operation is performed. You are prompted to insert the disks at the appropriate times. DISKCOPY waits for you to press any key before continuing.

After copying, DISKCOPY prompts:

Copy complete
Copy another (Y/N)?

If you press Y, the next copy is performed on the same drives that you originally specified, after you have been prompted to insert the proper disks.

To end the COPY, press N.

Notes:

1. If you omit both options, a single-drive copy operation will be performed on the default drive.
2. If you omit the second option, the default drive will be used as the destination drive.

3. Both disks must have the same number of physical sectors and those sectors must be the same size.
4. Disks that have had a lot of file creation and deletion activity become fragmented, because disk space is not allocated sequentially. The first free sector found is the next sector allocated, regardless of its location on the disk.

A fragmented disk can cause poor performance due to delays involved in finding, reading, or writing a file. If this is the case, you must use the COPY command, instead of DISKCOPY, to copy your disk and eliminate the fragmentation.

For example:

COPY A:.* B:

copies all files from the disk in drive A to the disk in drive B.

5. DISKCOPY automatically determines the number of sides to copy, based on the source drive and disk.
6. If disk errors are encountered during a DISKCOPY, MS-DOS displays:

DISK error while reading drive A
Abort, Ignore, Retry?

Refer to Appendix B, Disk Errors, for information on this error message.

NAME	TYPE
EXE2BIN	External

PURPOSE

Converts .EXE (executable) files to binary format. This results in a saving of disk space and faster program loading.

SYNTAX

EXE2BIN <filespec> [d:][<filename>[<.ext>]]

COMMENTS

This command is useful only if you want to convert .EXE files to binary format. The file named by filespec is the input file. If no extension is specified, it defaults to .EXE. The input file is converted to .COM file format (memory image of the program) and placed in the output file. If you do not specify a drive, the drive of the input file will be used. If you do not specify an output filename, the input filename will be used. If you do not specify a filename extension in the output filename, the new file will be given an extension of .BIN.

The input file must be in valid .EXE format produced by the linker. The resident, or actual code and data part of the file must be less than 64K. There must be no STACK segment.

Two kinds of conversions are possible, depending on whether the initial CS:IP (Code Segment:Instruction Pointer) is specified in the .EXE file:

1. If CS:IP is not specified in the .EXE file, a pure binary conversion is assumed. If segment fixups are necessary (i.e., the program contains instructions requiring segment relocation), you will be prompted for the fixup value. This value is the absolute segment at which the program is to be loaded. The resulting program will be usable only when loaded at the absolute memory address specified by a user application. The command processor will not be capable of properly loading the program.

2. If CS:IP is specified as 0000:100H, it is assumed that the file is to be run as a .COM file with the location pointer set at 100H by the assembler statement ORG; the first 100H bytes of the file are deleted. No segment fixups are allowed, as .COM files must be segment relocatable; that is, they must assume the entry conditions explained in the MS-DOS Programmer's Manual. Once the conversion is complete, you may rename the resulting file with a .COM extension. Then the command processor will be able to load and execute the program in the same way as the .COM programs supplied on your MS-DOS disk.

If CS:IP does not meet either of these criteria, or if it meets the .COM file criterion but has segment fixups, the following message will be displayed:

File cannot be converted

This message is also displayed if the file is not a valid executable file.

If EXE2BIN finds an error, one or more of the following error messages will be displayed:

File not found

The file is not on the disk specified.

Insufficient memory

There is not enough memory to run EXE2BIN.

File creation error

EXE2BIN cannot create the output file. Run CHKDSK to determine if the directory is full, or if some other condition caused the error.

Insufficient disk space

There is not enough disk space to create a new file.

Fixups needed - base segment (hex):

The source (.EXE) file contained information indicating that a load segment is required for the file. Specify the absolute segment address at which the finished module is to be located.

File cannot be converted

The input file is not in the correct format.

WARNING -Read error on EXE file.

Amount read less than size in header

This is a warning message only.

NAME	TYPE
EXIT	Internal

PURPOSE

Exits the program COMMAND.COM (the command processor) and returns to a previous level, if one exists.

SYNTAX

EXIT

COMMENTS

This command can be used when you are running an application program and want to start the MS-DOS command processor, then return to your program. For example, to look at a directory on drive B while running an application program, you must start the command processor by typing COMMAND in response to the default drive prompt:

A:COMMAND

You can now type the DIR command and MS-DOS will display the directory for the default disk. When you type EXIT, you return to the previous level (your application program).

NAME	TYPE
FIND	External

PURPOSE
Searches for a specific string of text in a file or files.

SYNTAX
FIND [/V /C /N] <string> [<filename...>]

COMMENTS
FIND is a filter that takes as options a string and a series of filenames. It will display all lines that contain a specified string from the files specified in the command line.

If no files are specified, FIND will take the input on the screen and display all lines that contain the specified string.

Switches for FIND are:

/V	causes FIND to display all lines not containing the specified string.
/C	causes FIND to print only the count of lines that contained a match in each of the files.
/N	causes each line to be preceded by its relative line number in the file.

The string should be enclosed in quotes.
Example:

FIND "Fool's Paradise" BOOK1.TXT BOOK2.TXT

displays all lines from BOOK1.TXT and BOOK2.TXT (in that order) that contain the string "Fool's Paradise." The command

DIR B: | FIND /V "DAT"

causes MS-DOS to display all names of the files on the disk in drive B which do not contain the string DAT. Type double quotes around a string that already has quotes in it.

When an error is detected, FIND responds with one of the following error messages:

Incorrect DOS version
FIND will only run on versions of MS-DOS that are 2.0 or higher.

FIND: Invalid number of parameters
You did not specify a string when issuing the FIND command.

FIND: Syntax error
You typed an illegal string when issuing the FIND command.

FIND: File not found <filename>
The filename you have specified does not exist or FIND cannot find it.

FIND: Read error in <filename>
An error occurred when FIND tried to read the file specified in the command.

FIND: Invalid parameter <option-name>
You specified an option that does not exist.

COMMANDS

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NAME	TYPE
FORMAT	External

PURPOSE

Formats a floppy or hard disk in the specified drive to accept MS-DOS files.

SYNTAX

FORMAT [d]:[/C] [/D] [/O] [/S] [/1] [/2] [/9]

COMMENTS

This command initializes the directory and file allocation tables. If no drive is specified, the disk in the default drive is formatted.

If the /D switch is specified, the disk will be formatted double density (floppy disks only). If /C is used, the disk will not actually be formatted, but a bad sector check will be performed and the directory and File Allocation Tables will be cleared (both floppy and hard disks).

The /O switch causes FORMAT to produce an IBM personal computer DOS version 1.X compatible disk (floppy disks only). The /O switch causes FORMAT to reconfigure the directory with an OE5 hex byte at the start of each entry so that the disk may be used with 1.X versions of IBM PC DOS, as well as MS-DOS 1.25/2.00 and IBM PC DOS 2.00. This switch should only be given when needed because it takes a fair amount of time for FORMAT to perform the conversion, and it noticeably decreases 1.25 and 2.00 performance on disks with few directory entries.

If the /S switch is specified, FORMAT copies operating system files from the disk in the default drive to the newly formatted disk. The /S switch may be used for both floppy and hard disks. The files are copied in the following order:

IO.SYS
MSDOS.SYS
COMMAND.COM

The /1 and /2 specify single- or double-sided disk format.

/1 - Single-sided disk format

/2 - Double-sided disk format

Setting the /1 or /2 switch overrides the standard default for single- or double-sided format as specified in the IODEF.ASM file. For 5.25-inch drives, the /1 or /2 switch overrides the default equate set up in IODEF.ASM. For 8-inch drives, the /1 or /2 switch overrides the default equate in IODEF.ASM, but does not override the SIDECHECK equate in IODEF.ASM.

The /9 switch generates 9-sector IBM PC 5.25-inch format as supplied under PC-DOS 2.0 (floppy disk only).

NAME	TYPE
FUNKEY	External

PURPOSE

Allows you to assign each of the MS-DOS template editing actions to a function key on your terminal or to an escape sequence.

SYNTAX

FUNKEY

COMMENTS

The MS-DOS special editing keys make input easier for you as you use MS-DOS. By using the editing keys, you assign an editing function to a key. These decreases the amount of typing you have to do when using MS-DOS. These special keys are described in detail in Chapter 6.

The FUNKEY command lets you assign an editing function to a function key on your keyboard or to an escape sequence. For example, a key may be set up that enters insert mode. By using FUNKEY, you can assign this key to be, for example, PF1 on your keyboard, or to be ESC-3 on your keyboard.

To use FUNKEY, simple type:

FUNKEY

You will see a display something like this:

FUNCTION KEY MENU

- | | |
|--------------|--|
| | (0) End program |
| <2> | (1) Put a CTRL-Z in the template |
| <1> | (2) Copy one character from template |
| <2> <i>D</i> | (3) Skip over one character in template |
| <T> <i>C</i> | (4) Copy up to specified character |
| <W> <i>F</i> | (5) Skip up to specified character |
| <3> <i>R</i> | (6) Copy rest of template |
| <E> <i>X</i> | (7) Kill line with no change in template (Ctrl-X) |
| <J> <i>E</i> | (8) Re-edit line |
| <D> <i>H</i> | (9) Backspace (same as Ctrl-H) |
| <4> <i>I</i> | (10) Toggle insert mode |
| <Q> | (11) Toggle insert mode |
| <R> | (12) Represent escape character |

|_ 2nd char present escape char -->

Select menu item number __

Then you select one of the menu item numbers. For example, if you choose 1 for the Put a CTRL-Z in the template function, you would type:

Select menu item number 1

You will then see this message:

Press function key to put a CTRL-Z in the template
>>

At this point, do one of two things: either press the function key or press ESC followed by another character. For example, you might press PF1 or ESC-3. This will assign that function to PF1 or ESC-3.

After doing this, an asterisk will appear on the display:

<3> (1)*Put a CTRL-Z in the template

After you have made all the changes you want to make and you want to save the changes, type:

0

If you decide you do not want to save the changes after all, type CTRL-C.

NAME	TYPE
INSTALL	External

PURPOSE
Copies a file to the hidden IO.SYS file.

SYNTAX
INSTALL filespec [d:]

COMMENTS
INSTALL is used when you create or update the I/O system. INSTALL copies a file to the hidden IO.SYS file in drive d: or to the default drive if no drive is specified in the command. You must be in the root directory to use this command.

IO.SYS is the file from which the input/output system is loaded when MS-DOS is booted up. This command is necessary since IO.SYS, being hidden, cannot be accessed by normal means. The file being copied to IO.SYS can be hidden itself, which allows copying IO.SYS from one disk to another.

INSTALL never changes the size of the IO.SYS file, which is important since IO.SYS must always be the same size and at the same place on the disk for the boot loader to find it. If the file being copied to IO.SYS is larger than IO.SYS, you will see this message:

NEW I/O SYSTEM TOO BIG

If IO.SYS does not exist, you will see this message:

IO.SYS NOT PRESENT ON DESTINATION

If the file being copied to IO.SYS does not exist, you will see this message:

FILE NOT FOUND

NAME	TYPE
MEMTEST	External

PURPOSE

Tests the Seattle Computer Products 64k RAM board and the 8/16k RAM board

SYNTAX

MEMTEST

COMMENTS

This command tests the 64k RAM board and the 8/16k RAM board from Seattle Computer Products. It can test up to sixteen 16k or 64k boards in any mix.

The tests prompts you for information on each board. When you are prompted, you enter:

Address - Enter the beginning address (in hexadecimal) of the board. If you do not know the addresses of your boards, use your memory board manuals to interpret the settings of the address switches on the boards.

Size - Enter either 16 or 64, as appropriate for the board.

Delay - Enter a delay time (0 to 9, A to F seconds) to be used between the write and read passes of the Memory Chip Test. The delay is designed to find errors in static memory chips which act dynamic and forget data shortly after it is written.

There are some restrictions on the addresses of boards which can be tested. MEMTST does not allow you to test any memory in which MS-DOS or MEMTEST are residing. To test all the memory in a system, the bottom 32k will have to be swapped with some memory at a higher address. The addresses must also be on a 16-byte boundary (that is, the last digit of the address must be zero).

If less than 16 boards are to be tested, just enter RETURN when prompted for the address of the next board to start the test. If 16 boards are tested, the test will start automatically when information for all 16 boards is entered.

The following tests are performed:

Read-Only Test - This test checks the data path from the memory chip through the board's output buffers to the bus. It also checks the enabling circuits of the board which allow a memory read operation to take place.

The test operates by assuming the memory board contains random data when the test begins. Each block is scanned to see if any data bits are always high or always low. If the condition is found, an error message is displayed. In case the board happened to have all high or low, a word of all zeros and a word of all ones is written to the board to see if both ones and zeros can be read from each bit.

Data Line Test - This test checks the data path into the board from the bus, through the input buffers, to the memory chips, then back out to the bus as does the Read Only Test. The write circuitry is also checked.

This test and the Read Only Test complement one another. The Read Only Test checks the data path out of the board, while the Data Line Test checks the data path entering the board.

This test attempts to write and read back every combination of 16 bits into selected locations. If no location is found that passes this simple test, a check is made for data bits that are always high, always low, or shorted together.

Address Line Test - This test checks the address path from the S-100 connector, through the address buffers, to the memory chips.

The address lines are tested by writing a pattern to each memory location which is derived from that location's address. This makes the test sensitive to addressing problems such as shorted or open address lines, and allows identification of the line(s) with a fault.

Memory Chip Test - This test detects and isolates defective or marginal memory chips on the board being tested.

The test is performed by writing a test pattern into memory and then checking it immediately.

After the pattern has been written to the entire board, the program waits for the user-specified delay (from 0 to 15 seconds) and then checks the entire board again. The pattern is then rotated and the test is performed for a total of 17 times. Then the pattern is complemented and the test is repeated. After this, a pattern of either all zeros or all ones is written to every location of the board. Next time the Memory Chip Test checks the board, the first thing it does is check this pattern for bits that have changed. This test is intended to find soft errors caused by alpha particles.

Test Sequence - For each of the boards to be tested, the Read Only Test, Data Line Test, and Address Line Test are performed. After these tests have been performed on all boards, the Memory Chip test is done to each board. The test then loops indefinitely doing the Memory Chip Test over and over until stopped.

Stopping the Test and Reading Test Results - Any errors that occur while the test is running are stored so they can be printed later. If CTRL-C is typed anytime during the test, the entire history of successes or failures for each board is printed and control is returned to MS-DOS. Any time during the Memory Chip Test, you may type ESCAPE to print the success/failure history and resume the test.

Interpretation of Test Results - MEMTEST indicates errors in terms of bits and blocks which correspond to the bits and blocks of the Seattle Computer Products 16k and 64k Static RAM boards as defined in the Trouble-Shooting sections of these boards' manuals.

These boards each have two blocks of memory chips. For the 16k board, the blocks are 8k bytes (or 4k words) long, and for the 64k Static RAM the blocks are 32 bytes (or 16k words) long. All the blocks are 16 bits wide. The block number defines the tens digit of a memory chip's IC number. The bit number defines the ones digit of a memory chip's IC number. For example, if an error is indicated in bit E of block 2, U2E should be the bad chip.

When interpreting test results, remember that the memory test is a sequential test consisting

of several sub-tests. So validity of sub-tests late in the sequence is dependent on successful earlier sub-tests. For this reason, the earliest sub-test in which a fault is detected can be the most significant. Examples:

1. If the board fails the Read-Only Test, the results of the rest of the tests cannot be believed since they depend on the data path from the memory chips out to the data bus to work.
2. If the board fails the Address Line Test, the Memory Chip Test will not produce reliable results because the address problems will usually cause all bits of all blocks to fail the Memory Chip Test.

NAME	TYPE
MKDIR	Internal

SYNONYM
MD

PURPOSE
Makes a new directory.

SYNTAX
MKDIR <pathname>

COMMENTS
This command is used to create a hierarchical directory structure. When you are in your root directory, you can create subdirectories by using the MKDIR command. The command

MKDIR \USER

will create a subdirectory \USER in your root directory. To create a directory named JOE under \USER, type:

MKDIR \USER\JOE

NAME	TYPE
MORE	External

PURPOSE
Sends output to console one screen at a time.

SYNTAX
MORE

COMMENTS
MORE is a filter that reads from standard input (such as a command from your terminal) and displays one screen of information at a time. The MORE command then pauses and displays the --MORE-- message at the bottom of your screen.

Pressing the <RETURN> key will display another screen of information. This process continues until all the input data has been read.

The MORE command is useful for viewing a long file one screen at a time. If you type

TYPE MYFILES.COM | MORE

MS-DOS will display the file MYFILES.COM (on the default drive) one screen at a time.

NAME	TYPE
PATH	Internal

PURPOSE
Sets a command path.

SYNTAX
PATH [<pathname>[;<pathname>]...]

COMMENTS
This command allows you to tell MS-DOS which directories should be searched for external commands after MS-DOS searches your working directory. The default value is \BIN, where \BIN is the name of the directory in which all MS-DOS external commands reside.

To tell MS-DOS to search your \BIN\USER\JOE directory for external commands (in addition to a search of the \BIN directory), type:

PATH \BIN\USER\JOE

MS-DOS will now also search the \BIN\USER\JOE directory for external commands until you set another path or shut down MS-DOS.

You can tell MS-DOS to search more than one path by specifying several pathnames separated by semicolons. For example,

PATH \BIN\USER\JOE;\BIN\USER\SUE;\BIN\DEV

tells MS-DOS to search the directories specified by the above pathnames to find external commands. MS-DOS searches the pathnames in the order specified in the PATH command.

The command PATH with no options will print the current path. If you specify PATH ;, MS-DOS will set the NUL path, meaning that only the working directory will be searched for external commands.

NAME	TYPE
PRINT	External

PURPOSE

Prints a text file on a line printer while you are processing other MS-DOS commands (usually called "background printing").

SYNTAX

PRINT [[filespec] [/T] [/C] [/P]]...

COMMENTS

You will use the PRINT command only if you have a line printer attached to your computer. The following switches are provided with this command:

/T TERMINATE: this switch deletes all files in the print queue (those waiting to be printed). A message to this effect will be printed.

/C CANCEL: This switch turns on cancel mode. The preceding filespec and all following filespecs will be suspended in the print queue until you type a /P switch.

/P PRINT: This switch turns on print mode. The preceding filespec and all following filespecs will be added to the print queue until you issue a /C switch.

PRINT with no options displays the contents of the print queue on your screen without affecting the queue.

Examples:

PRINT /T empties the print queue.

PRINT /T *.ASM empties the print queue and queues all .ASM files on the default drive.

PRINT A:TEMP1.TST/C A:TEMP2.TST A:TEMP3.TST
removes the three files
indicated from the print
queue.

PRINT TEMP1.TST /C TEMP2.TST /P TEMP3.TST
removes TEMP1.TST from the
queue, and adds TEMP2.TST
and TEMP3.TST to the
queue.

If an error is detected, PRINT will display
one of the following error messages:

Name of list device [PRN:]

This prompt appears when PRINT is run
the first time. Any current device may
be specified and that device then
becomes the PRINT output device. As
indicated in the [], simply pressing
<RETURN> results in the device PRN
being used.

List output is not assigned to a device

This message will be displayed if the
"Name of list device" specified to the
above prompt is invalid. Subsequent
attempts will return the same message
until a valid device is specified.

PRINT queue is full

There is room for 10 files in the
queue. If you attempt to put more than
10 files in the queue, this message
will appear on the console.

PRINT queue is empty

There are no files in the print queue.

No files match d:XXXXXXXX.XXX

A filespec was given for files to add
to the queue, but no files match a
specification. NOTE: if there are no
files in the queue to match the
canceled filespec, no error message
will appear.

Drive not ready

If this message occurs when PRINT
attempts a disk access, PRINT will keep
trying until the drive is ready. Any
other error causes the current file to
be canceled. An error message would be

output on your printer in such a case.
All files canceled
If the /T (TERMINATE) switch is issued,
the message "All files canceled by
operator" will be output on your
printer. If the current file being
printed is canceled by a /C, the
message "File canceled by operator"
will be printed.

NAME	TYPE
PROMPT	Internal

PURPOSE
Changes the MS-DOS command prompt.

SYNTAX
PROMPT [<prompt-text>]

COMMENTS
This command allows you to change the MS-DOS system prompt (for example, A:). If no text is typed, the prompt will be set to the default prompt, which is the default drive designation. You can set the prompt to a special prompt, such as the current time, by using the characters indicated below.

The following characters can be used in the prompt command to specify special prompts. They must all be preceded by a dollar sign (\$) in the prompt command:

Specify
This
Character To Get This Prompt:

\$ - The '\$' character
t - The current time
d - The current date
p - The current directory of the default drive
v - The version number
n - The default drive
g - The '>' character
l - The '<' character
b - The '|' character
- A CR LF sequence
s - A space (leading only)
h - A backspace
e - ASCII code 1BH (escape)

Examples:

```
PROMPT $n:  
      Sets the normal MS-DOS  
      prompt (:).  
PROMPT $n>  
      Sets the normal IBM  
      Personal Computer  
      DOS prompt (>).  
PROMPT Time = $t$ Date = $d  
      Sets a two-line prompt which  
      prints:  
      Time = (current time)  
      Date = (current date)
```

If your terminal has an ANSI escape sequence driver, then you can use escape sequences in your prompts. For example:

```
PROMPT $e[7m$n:$e[m  
      Sets the prompts in inverse  
      video mode and returns to  
      video mode for other  
      text.
```

NAME	TYPE
RECOVER	External

PURPOSE

Recover a file or an entire disk containing bad sectors.

SYNTAX

RECOVER <filename | d:>

COMMENTS

If a sector on a disk is bad, you can recover either the file containing that sector (without the bad sector) or the entire disk (if the bad sector was in the directory).

To recover a particular file, type:

RECOVER <filename>

This will cause MS-DOS to read the file sector by sector and to skip the bad sector(s). When MS-DOS finds the bad sector(s), the sector(s) are marked and MS-DOS will no longer allocate your data to that sector.

To recover a disk, type:

RECOVER <d:>

where d: is the letter of the drive containing the disk to be recovered.

If there is not enough room in the root directory, RECOVER will print a message and store information about the extra files in the File Allocation Table. You can run RECOVER again to regain these files when there is more room in the root directory.

NAME	TYPE
REM (REMARK)	Internal

PURPOSE

Displays remarks which are on the same line as the REM command in a batch file during execution of that batch file.

SYNTAX

REM [comment]

COMMENTS

The only separators allowed in the comment are the space, tab, and comma.

Example:

```
1: REM This file checks new disks
2: REM It is named NEWDISK.BAT
3: PAUSE Insert new disk in drive B:
4: FORMAT B:/S
5: DIR B:
6: CHKDSK B:
```

NAME	TYPE
REN (RENAME)	Internal

SYNONYM
RENAME

PURPOSE
Changes the name of the first option (filespec) to the second option (filename).

SYNTAX
REN <filespec> <filename>

COMMENTS
The first option (filespec) must be given a drive designation if the disk resides in a drive other than the default drive. Any drive designation for the second option (filename) is ignored. The file will remain on the disk where it currently resides.

The wild card characters may be used in either option. All files matching the first filespec are renamed. If wild card characters appear in the second filename, corresponding character positions will not be changed.

For example, the following command changes the names of all files with the .LST extension to similar names with the .PRN extension:

REN *.LST *.PRN

In the next example, REN renames the file ABODE on drive B to ADOBE:

REN B:ABODE ?D?B?

The file remains on drive B.

An attempt to rename a filespec to a name already present in the directory will result in the error message "File not found."

NAME	TYPE
RENDIR (RENAME DIRECTORY)	External

PURPOSE
Changes the name of a directory.

SYNTAX
RENDIR <directory-name> <directory-name>

COMMENTS
The RENDIR command renames a directory. The first directory name specified is the old directory name; the second name is the new directory name.

Before using this command, you must be in the parent directory of the directory being renamed.

For example, to rename a file in the SUE directory, you must be in the parent directory (or the directory one level higher than SUE). In our sample directory, the parent directory of SUE is USERS. Then you can change the name of the directory from SUE to JOAN:

```
CD \USERS  
RENDIR SUE JOAN
```

The wild card characters may be used in either directory name. All directories matching the first directory name are renamed. If wild card characters appear in the second directory name, corresponding character positions will not be changed.

For example, the following command changes the names of all directories that begin in P12 and end in .REP:

```
RENDIR P12*.REP
```

In this example, RENDIR renames the directory JOAN to JEAN:

```
RENDIR ?E??
```

NAME	TYPE
RMDIR (REMOVE DIRECTORY)	Internal

SYNONYM
RD

PURPOSE
Removes a directory from a hierarchical directory structure.

SYNTAX
RMDIR <pathname>

COMMENTS
This command removes a directory that is empty except for the . and .. shorthand symbols.

To remove the \BIN\USER\JOE directory, first issue a DIR command for that path to ensure that the directory does not contain any important files that you do not want deleted. Then type:

RMDIR \BIN\USER\JOE

The directory has been deleted from the directory structure.

NAME	TYPE
SET	Internal

PURPOSE
Sets one string value equivalent to another string for use in later programs.

SYNTAX
SET [<string=string>]

COMMENTS

This command is meaningful only if you want to set values that will be used by programs you have written. An application program can check all values that have been set with the SET command by issuing SET with no options. For example, SET TTY=VT52 sets your TTY value to VT52 until you change it with another SET command.

The SET command can also be used in batch processing. In this way, you can define your replaceable parameters with names instead of numbers. If your batch file contains the statement "LINK %FILE%", you can set the name that MS-DOS will use for that variable with the SET command. The command SET FILE = DOMORE replaces the %FILE% parameter with the filename DOMORE. Therefore, you do not need to edit each batch file to change the replaceable parameter names. Note that when you use text (instead of numbers) as replaceable parameters, the name must be ended by a percent sign.

NAME	TYPE
SHIPZONE	External

PURPOSE

Moves hard disk head to position for moving or shipping the hard disk.

SYNTAX

SHIPZONE

COMMENTS

Before moving or shipping a hard disk, you must use the SHIPZONE command, which moves the hard disk head to the shipping position.

CAUTION: If the SHIPZONE command is not used before moving the hard disk, your warranty will be invalidated!

To use this command, just type:

SHIPZONE

When you see the MS-DOS prompt, then turn the computer off.

NAME	TYPE
SORT	External

PURPOSE

SORT reads input from your terminal, sorts the data, then writes it to your terminal screen or files.

SYNTAX

SORT [/R] [/+n]

COMMENTS

SORT can be used, for example, to alphabetize a file by a certain column. There are two switches which allow you to select options:

/R reverse the sort; that is, sort from Z to A.

/+n sort starting with column n where n is some number. If you do not specify this switch, SORT will begin sorting from column 1.

Examples:

This command will read the file UNSORT.TXT, reverse the sort, and then write the output to a file named SORT.TXT:

```
SORT /R <UNSORT.TXT >SORT.TXT
```

The following command will pipe the output of the directory command to the SORT filter. The SORT filter will sort the directory listing starting with column 14 (this is the column in the directory listing that contains the file size), then send the output to the console. Thus, the result of this command is a directory sorted by file size:

```
DIR | SORT /+14
```

The command

```
DIR | SORT /+14 | MORE
```

will do the same thing as the command in the previous example, except that the MORE filter will give you a chance to read the sorted directory one screen at a time.

NAME	TYPE
SYS (SYSTEM)	External

PURPOSE

Transfers the MS-DOS system files from the disk in the default drive to the disk in the drive specified by d:.

SYNTAX

SYS <d>:

COMMENTS

SYS is normally used to update the system or to place the system on a formatted disk which contains no files. An entry for d: is required.

If IO.SYS and MSDOS.SYS are on the destination disk, they must take up the same amount of space on the disk as the new system will need. This means that you cannot transfer system files from an MS-DOS 2.0 disk to an MS-DOS 1.1 disk. You must reformat the MS-DOS 1.1 disk with the MS-DOS FORMAT command before the SYS command will work.

The destination disk must be completely blank or already have the system files IO.SYS and MSDOS.SYS.

The transferred files are copied in the following order:

IO.SYS
MSDOS.SYS

IO.SYS and MSDOS.SYS are both hidden files that do not appear when the DIR command is executed. COMMAND.COM (the command processor) is not transferred. You must use the COPY command to transfer COMMAND.COM.

If SYS detects an error, one of the following messages will be displayed:

No room for system on destination disk
There is not enough room on the destination disk for the IO.SYS and

MSDOS.SYS files.

Incompatible system size

The system files IO.SYS and MSDOS.SYS do not take up the same amount of space on the destination disk as the new system will need.

NAME	TYPE
TIME	Internal

PURPOSE
Displays and sets the time.

SYNTAX
TIME [<hh>[:<mm>]]

COMMENTS
If the TIME command is entered without any arguments, the following message is displayed:

Current time is <hh>:<mm>:<ss>.<cc>
Enter new time:_

Press the <RETURN> key if you do not want to change the time shown. A new time may be given as an option to the TIME command as in:

TIME 8:20

The new time must be entered using numerals only; letters are not allowed. The allowed options are:

<hh> = 00-24
<mm> = 00-59

The hour and minute entries must be separated by colons. You do not have to type the <ss> (seconds) or <cc> (hundredths of seconds) options.

MS-DOS uses the time entered as the new time if the options and separators are valid. If the options or separators are not valid, MS-DOS displays the message:

Invalid time
Enter new time:_

MS-DOS then waits for you to type a valid time.

NAME	TYPE
TYPE	Internal

PURPOSE

Displays the contents of the file on the console screen.

SYNTAX

TYPE <filespec>

COMMENTS

Use this command to examine a file without modifying it. (Use DIR to find the name of a file and EDLIN to alter the contents of a file.) The only formatting performed by TYPE is that tabs are expanded to spaces consistent with tab stops every eighth column. Note that a display of binary files causes control characters (such as CONTROL-Z) to be sent to your computer, including bells, form feeds, and escape sequences.

NAME

VER

TYPE

Internal

PURPOSE

Prints MS-DOS version number.

SYNTAX

VER

COMMENTS

If you want to know what version of MS-DOS you are using, type VER. The version number will be displayed on your screen.

NAME	TYPE
VERIFY	Internal

PURPOSE
Turns the verify switch on or off when writing to disk.

SYNTAX
VERIFY [ON|OFF]

COMMENTS

This command has the same purpose as the -V switch in the COPY command. If you want to verify that all files are written correctly to disk, you can use the VERIFY command to tell MS-DOS to verify that your files are intact (no bad sectors, for example). MS-DOS will perform a VERIFY each time you write data to a disk. You will receive an error message only if MS-DOS was unable to successfully write your data to disk.

VERIFY ON remains in effect until you change it in a program (by a SET VERIFY system call), or until you issue a VERIFY OFF command to MS-DOS.

If you want to know what the current setting of VERIFY is, type VERIFY with no options.

NAME	TYPE
VOL (VOLUME)	Internal

PURPOSE
Displays disk volume number, if it exists.

SYNTAX
VOL [d:]

COMMENTS
This command prints the volume label of the disk in drive d:. If no drive is specified, MS-DOS prints the volume label of the disk in the default drive.

If the disk does not have a volume label, VOL displays:

Volume in drive d has no label

5.3 BATCH PROCESSING COMMANDS

The following commands are called batch processing commands. They can add flexibility and power to your batch programs. The commands discussed are ECHO, FOR, GOTO, IF, and SHIFT.

If you are not writing batch programs, you do not need to read this section.

NAME	TYPE
ECHO	Internal

PURPOSE
Turns batch echo feature on and off.

SYNTAX
ECHO [ON |OFF| message]

COMMENTS
Normally, commands in a batch file are displayed ("echoed") on the console when they are seen by the command processor. ECHO OFF turns off this feature. ECHO ON turns the echo back on.

If ON or OFF are not specified, the current setting is displayed.

NAME	TYPE
FOR	Internal

PURPOSE

Command extension used in batch and interactive file processing.

SYNTAX

```
FOR %%<c> IN <set> DO <command> - for batch
processing
FOR %<c> IN <set> DO <command> - for
interactive processing
```

COMMENTS

<c> can be any character except 0,1,2,3,...,9 to avoid confusion with the %0-%9 batch parameters.

<set> is (#<item>*#)

The %%<c> variable is set sequentially to each member of <set>, and then <command> is evaluated. If a member of <set> is an expression involving * and\or ?, then the variable is set to each matching pattern from disk. In this case, only one such <item> may be in the set, and any <item> besides the first is ignored.

NOTE: The words IN, FOR, and DO must be in uppercase.

Examples:

```
FOR %%f IN ( *.ASM ) DO MASM %%f;
```

```
FOR %%f IN (FOO BAR BLECH) DO REM %%f
```

The '%%' is needed so that after batch parameter (%0-%9) processing is done, there is one '%' left. If only '%f' were there, the batch parameter processor would see the '%', look at 'f', decide that '%f' was an error (bad parameter reference) and throw out the '%f', so that the command FOR would never see it. If the FOR is not in a batch file, then only one '%' should be used.

NAME	TYPE
GOTO	Internal

PURPOSE
Command extension used in batch file processing.

SYNTAX
GOTO <label>

COMMENTS
GOTO causes commands to be taken from the batch file beginning with the line after the <label> definition. If no label has been defined, the current batch file will terminate.

Example:

```
:foo  
REM looping...  
GOTO foo
```

will produce an infinite sequence of messages:
REM looping....

Starting a line in a batch file with '::' causes the line to be ignored by batch processing. The characters following GOTO define a label, but this procedure may also be used to put in comment lines.

NAME	TYPE
IF	Internal

PURPOSE
Command extension used in batch file processing.

SYNTAX
IF <condition> <command>

COMMENTS
The parameter <condition> is one of the following:

ERRORLEVEL <number>
True if and only if the previous program executed by COMMAND had an exit code of <number> or higher.

<string1> == <string2>
True if and only if <string1> and <string2> are identical after parameter substitution. Strings may not have embedded separators.

EXIST <filename>
True if and only if <filename> exists.

NOT <condition>
True if and only if <condition> is false.

The IF statement allows conditional execution of commands. When the <condition> is true, then the <command> is executed. Otherwise, the <command> is ignored.

NOTE: The words ERRORLEVEL, EXIST, and NOT must be uppercase.

Examples:

```
IF NOT EXIST \TMP\FOO ECHO Can't find file
```

```
IF NOT ERRORLEVEL 3 LINK $1,,,;
```

NAME	TYPE
PAUSE	Internal

PURPOSE
Suspends execution of the batch file.

SYNTAX
PAUSE [comment]

COMMENTS
During the execution of a batch file, you may need to change disks or perform some other action. PAUSE suspends execution until you press any key, except <CONTROL-C>.

When the command processor encounters PAUSE, it prints:

Strike a key when ready . . .

If you press <CONTROL-C>, another prompt will be displayed:

Abort batch job (Y/N)?

If you type "y" in response to this prompt, execution of the remainder of the batch command file will be aborted and control will be returned to the operating system command level. Therefore, PAUSE can be used to break a batch file into pieces, allowing you to end the batch command file at an intermediate point.

The comment is optional and may be entered on the same line as PAUSE. You may also want to prompt the user of the batch file with some meaningful message when the batch file pauses. For example, you may want to change disks in one of the drives. An optional prompt message may be given in such cases. The comment prompt will be displayed before the "Strike a key" message.

NAME	TYPE
SHIFT	Internal

PURPOSE

Allows access to more than 10 replaceable parameters in batch file processing.

SYNTAX

SHIFT

COMMENTS

Usually, command files are limited to handling 10 parameters, %0 through %9. To allow access to more than ten parameters, use SHIFT to change the command line parameters. For example:

```
if      %0 = "foo"  
      %1 = "bar"  
      %2 = "name"  
      %3...%9 are empty
```

then a SHIFT will result in the following:

```
%0 = "bar"  
%1 = "name"  
%2...%9 are empty
```

If there are more than 10 parameters given on a command line, those that appear after the 10th (%9) will be shifted one at a time into %9 by successive shifts.

CHAPTER 6
MS-DOS EDITING AND FUNCTION KEYS

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6.1 SPECIAL MS-DOS EDITING KEYS

The special editing keys deserve particular emphasis because they depart from the way in which most operating systems handle command input. You do not have to type the same sequences of keys repeatedly, because the last command line is automatically placed in a special storage area called a template.

By using the template and the special editing keys, you can take advantage of the following MS-DOS features:

1. A command line can be instantly repeated by pressing two keys.
2. If you make a mistake in the command line, you can edit it and retry without having to retype the entire command line.
3. A command line that is similar to a preceding command line can be edited and executed with a minimum of typing by pressing a special editing key.

The relationship between the command line and the template is shown in Figure 8.

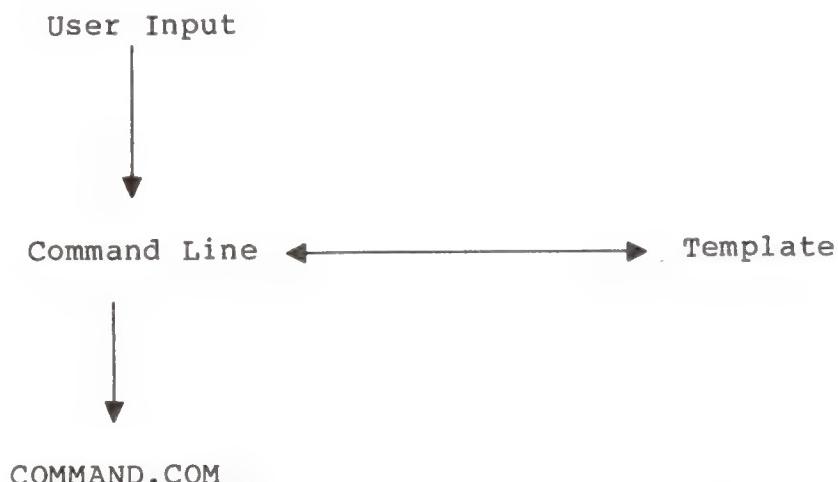


Figure 8. Command Line and Template

As seen in Figure 8, the user (you) types a command to MS-DOS on the command line. When you press the <RETURN> key, the command is automatically sent to the command processor (COMMAND.COM) for execution. At the same time, a copy of this command is sent to the template. You can now recall the command or modify it with MS-DOS special editing keys.

Table 6.1 contains a complete list of the special editing keys. Each of these keys is more fully described in Chapter 7, The Line Editor (EDLIN), where they can be used to edit your text files.

NOTE

The keys on your keyboard may not correspond to the specific keys in the following examples. Therefore, these MS-DOS editing keys will be referred to by FUNCTION rather than by name. When an example says to press the <SKIP1> key, find the key on your keyboard that corresponds to the "skip one character" editing function and press it. Some functions will require you to press two keys. Refer to the FUNKEY command described in Chapter 5 for details on how to associate each editing function with your particular keyboard.

You may wish to write in the keys on your keyboard that correspond to the editing keys described below. Space is provided in the following table to do this.

Table 6.1 Special Editing Functions

Key	Editing Function	Your Keyboard
<COPY1>	Copies one character from the template to the command line	
<COPYUP>	Copies characters up to the character specified in the template and puts these characters on the command line	
<COPYALL>	Copies all remaining characters in the template to the command line	
<SKIP1>	Skips over (does not copy) a character in the template	
<SKIPUP>	Skips over (does not copy) the characters in the template up to the character specified	
<VOID>	Voids the current input; leaves the template unchanged	
<INSERT>	Enters insert mode	
<EXIT>	Turns insert mode off; this is the default mode	
<NEWLINE>	Makes the new line the new template	
<CONTROL-Z>	Puts a CONTROL-Z (1AH) end-of-file character in the new template	

Example:

If you type the following command

```
DIR PROG.COM
```

MS-DOS displays information about the file PROG.COM on your screen. The command line is also saved in the template. To repeat the command, just press two keys: <COPYALL> and <RETURN>.

The repeated command is displayed on the screen as you type, as shown below:

```
<COPYALL>DIR PROG.COM<RETURN>
```

Notice that pressing the <COPYALL> key causes the contents of the template to be copied to the command line; pressing <RETURN> causes the command line to be sent to the command processor for execution.

If you want to display information about a file named PROG.ASM, you can use the contents of the template and type:

```
<COPYUP>C
```

Typing <COPYALL>C copies all characters from the template to the command line, up to but not including "C". MS-DOS displays:

```
DIR PROG._
```

Note that the underline is your cursor. Now type:

```
.ASM
```

The result is:

```
DIR PROG.ASM_
```

The command line "DIR PROG.ASM" is now in the template and ready to be sent to the command processor for execution. To do this, press <RETURN>.

Now assume that you want to execute the following command:

```
TYPE PROG.ASM
```

To do this, type:

```
TYPE<INSERT> <COPYALL><RETURN>
```

Notice that when you are typing, the characters are entered directly into the command line and overwrite corresponding characters in the template. This automatic replacement feature is turned off when you press the insert key. Thus, the characters "TYPE" replace the characters "DIR " in the template. To insert a space between "TYPE" and "PROG.ASM", you pressed <INSERT> and then the space bar. Finally, to copy the rest of the template to the command line, you pressed <COPYALL> and then <RETURN>. The command TYPE PROG.ASM has been processed by MS-DOS, and the template becomes "TYPE PROG.ASM".

If you had misspelled "TYPE" as "BYTE", a command error would have occurred. Still, instead of throwing away the whole command, you could save the misspelled line before you press <RETURN> by creating a new template with the <NEWLINE> key:

```
BYTE PROG.ASM<NEWLINE>
```

You could then edit this erroneous command by typing:

```
T<COPY1>P<COPYALL>
```

The <COPY1> key copies a single character from the template to the command line. The resulting command line is then the command that you want:

```
TYPE PROG.ASM
```

As an alternative, you can use the same template containing BYTE PROG.ASM and then use the <SKIP1> and <INSERT> keys to achieve the same result:

```
<SKIP1><SKIP1><COPY1><INSERT>YP<COPYALL>
```

To illustrate how the command line is affected as you type, examine the keys typed on the left; their effect on the command line is shown on the right:

<SKIP1>	-	Skips over 1st template character
<SKIP1>	-	Skips over 2nd template character
<COPY1>	T	Copies 3rd template character
<INSERT>YP	TYP	Inserts two characters
<COPYALL>	TYPE PROG.ASM	Copies rest of template

Notice that <SKIP1> does not affect the command line. It affects the template by deleting the first character. Similarly, <SKIPUP> deletes characters in the template, up to but not including a given character.

These special editing keys can add to your effectiveness at the keyboard. The next section describes control character functions that can also help when you are typing commands.

6.2 CONTROL CHARACTER FUNCTIONS

A control character function is a function that affects the command line. You have already learned about <CONTROL-C> and <CONTROL-S>. Other control character functions are described below.

Remember that when you type a control character, such as <CONTROL-C>, you must hold down the control key and then press the "C" key.

Table 6.2 Control Character Functions

Control Character	Function
<CONTROL-N>	Toggles echoing of output to line printer.
<CONTROL-C>	Aborts current command.
<CONTROL-H>	Removes last character from command line, and erases character from terminal screen.
<CONTROL-J>	Inserts physical end-of-line, but does not empty command line. Use the <LINE FEED> key to extend the current logical line beyond the physical limits of one terminal screen.
<CONTROL-P>	Toggles terminal output to line printer.
<CONTROL-S>	Suspends output display on terminal screen. Press any key to resume.
<CONTROL-X>	Cancels the current line; empties the command line; and then outputs a back slash (\), carriage return, and line feed. The template used by the special editing commands is not affected.

CHAPTER 7
THE LINE EDITOR (EDLIN)

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7.1 INTRODUCTION

In this chapter, you will learn how to use EDLIN, the line editor program. You can use EDLIN to create, change, and display files, whether they are source program or text files.

You can use EDLIN to:

Create new source files and save them.

Update existing files and save both the updated and original files.

Delete, edit, insert, and display lines.

Search for, delete, or replace text within one or more lines.

The text in files created or edited by EDLIN is divided into lines, each up to 253 characters long. Line numbers are generated and displayed by EDLIN during the editing process, but are not actually present in the saved file.

When you insert lines, all line numbers following the inserted text advance automatically by the number of lines being inserted. When you delete lines in a file, all line numbers following the deleted text decrease automatically by the number of lines deleted. As a result, lines are always numbered consecutively in your file.

7.2 HOW TO START EDLIN

To start EDLIN, type:

EDLIN <filespec>

If you are creating a new file, the <filespec> should be the name of the file you wish to create. If EDLIN does not find this file on a drive, EDLIN will create a new file with the name you specify. The following message and prompt will be displayed:

New file
*
-

Notice that the prompt for EDLIN is an asterisk (*).

You can now type lines of text into your new file. To begin entering text, you must enter an I (Insert) command to insert lines. The I command is discussed later in this chapter.

If you want to edit an existing file, <filespec> should be the name of the file you want to edit. When EDLIN finds the file you specify on the designated or default drive, the file will be loaded into memory. If the entire file can be loaded, EDLIN will display the following message on your screen:

```
End of input file
*
```

You can then edit the file using EDLIN editing commands.

If the file is too large to be loaded into memory, EDLIN will load lines until memory is 3/4 full, then display the * prompt. You can then edit the portion of the file that is in memory.

To edit the remainder of the file, you must save some of the edited lines on disk to free memory; then EDLIN can load the unedited lines from disk into memory. Refer to the Write and Append commands in this chapter for the procedure.

When you complete the editing session, you can save the original and the updated (new) files by using the End command. The End command is discussed in this chapter in the section EDLIN Commands. The original file is renamed with an extension of .BAK, and the new file has the filename and extension you specify in the EDLIN command. The original .BAK file will not be erased until the end of the editing session, or until disk space is needed by the editor (EDLIN).

Do not try to edit a file with a filename extension of .BAK because EDLIN assumes that any .BAK file is a backup file. If you find it necessary to edit such a file, rename the file with another extension (using the MS-DOS RENAME command discussed in Chapter 5), then start EDLIN and specify the new <filespec>.

7.3 SPECIAL EDITING KEYS

The special editing keys and template discussed in Chapter 6 can be used to edit your text files. These keys are discussed in detail in this section.

Table 7.1 summarizes the commands, codes, and functions. Descriptions of the special editing keys follow the table.

NOTE

The keys on your keyboard may not correspond to the specific keys in the following examples. Therefore, these MS-DOS editing keys will be referred to by FUNCTION rather than by name. When an example says to press the <SKIPL> key, find the key on your keyboard that corresponds to the "skip one character" editing function and press it. Some functions will require you to press two keys. The FUNKEY command is used to associate the keys on your keyboard with the MS-DOS editing functions (The FUNKEY command is described in Chapter 5.)

Table 7.1 Special Editing Keys

Function	Key	Description
Copy one character	<COPY1>	Copies one character from the template to the new line.
Copy up to character	<COPYUP>	Copies all characters from the template to the new line, up to the character specified.
Copy template	<COPYALL>	Copies all remaining characters in the template to the screen.
Skip one character	<SKIP1>	Does not copy (skips over) a character.
Skip up to character	<SKIPUP>	Does not copy (skips over) the characters in the template, up to the character specified.
Quit input	<VOID>	Voids the current input; leaves the template unchanged.
Insert mode	<INSERT>	Enters/exits insert mode.
Replace mode	<REPLACE>	Turns insert mode off; this is the default.
New template	<NEWLINE>	Makes the new line the new template.

KEY

<COPY1>

PURPOSE

Copies one character from the template to the command line.

COMMENTS

Pressing the <COPY1> key copies one character from the template to the command line. When the <COPY1> key is pressed, one character is inserted in the command line and insert mode is automatically turned off.

Example:

Assume that the screen shows:

```
1:*This is a sample file.  
1:*
```

At the beginning of the editing session, the cursor (indicated by the underline) is positioned at the beginning of the line. Pressing the <COPY1> key copies the first character (T) to the second of the two lines displayed:

```
1:*This is a sample file  
<COPY1> 1:*
```

Each time the <COPY1> key is pressed, one more character appears:

```
<COPY1> 1:*
```

T

```
<COPY1> 1:*
```

Th

```
<COPY1> 1:*
```

Thi

```
<COPY1> 1:*
```

This

```
_
```

KEY

<COPYUP>

PURPOSE

Copies multiple characters up to a given character.

COMMENTS

Pressing the <COPYUP> key copies all characters up to a given character from the template to the command line. The given character is the next character typed after <COPYUP>; it is not copied or displayed on the screen. Pressing the <COPYUP> key causes the cursor to move to the single character that is specified in the command. If the template does not contain the specified character, nothing is copied. Pressing <COPYUP> also automatically turns off insert mode.

Example:

Assume that the screen shows:

```
1:*This is a sample file.  
1:*_
```

At the beginning of the editing session, the cursor (indicated by the underline) is positioned at the beginning of the line. Pressing the <COPYUP> key copies all characters up to the character specified immediately after the <COPYUP> key.

```
1:*This is a sample file  
<COPYUP>p 1:*This is a sam_
```

KEY

<COPYALL>

PURPOSE

Copies template to command line.

COMMENTS

Pressing the <COPYALL> key copies all remaining characters from the template to the command line. Regardless of the cursor position at the time the <COPYALL> key is pressed, the rest of the line appears, and the cursor is positioned after the last character on the line.

Example:

Assume that the screen shows:

```
1:*This is a sample file.  
1:*_
```

At the beginning of the editing session, the cursor (indicated by the underline) is positioned at the beginning of the line. Pressing the <COPYALL> key copies all characters from the template (shown in the upper line displayed) to the line with the cursor (the lower line displayed):

```
1:*This is a sample file (template)  
<COPYALL> 1:_*This is a sample file._ (command  
line)
```

Also, insert mode is automatically turned off.

KEY

<SKIP1>

PURPOSE

Skips over one character in the template.

COMMENTS

Pressing the <SKIP1> key skips over one character in the template. Each time you press the <SKIP1> key, one character is not copied from the template. The action of the <SKIP1> key is similar to the <COPY1> key, except that <SKIP1> skips a character in the template rather than copying it to the command line.

Example:

Assume that the screen shows:

```
1:*This is a sample file.  
1:*
```

At the beginning of the editing session, the cursor (indicated by the underline) is positioned at the beginning of the line. Pressing the <SKIP1> key skips over the first character ("T").

```
1:*This is a sample file  
<SKIP1> 1:*
```

The cursor position does not change and only the template is affected. To see how much of the line has been skipped over, press the <COPYALL> key, which moves the cursor beyond the last character of the line.

```
1:*This is a sample file.  
<SKIP1> 1:  
<COPYALL> 1:*
```

KEY

<SKIPUP>

PURPOSE

Skips multiple characters in the template up to the specified character.

COMMENTS

Pressing the <SKIPUP> key skips over all characters up to a given character in the template. This character is not copied and is not shown on the screen. If the template does not contain the specified character, nothing is skipped over. The action of the <SKIPUP> key is similar to the <COPYUP> key, except that <SKIPUP> skips over characters in the template rather than copying them to the command line.

Example:

Assume that the screen shows:

```
1:*This is a sample file.  
1:*_
```

At the beginning of the editing session, the cursor (indicated by the underline) is positioned at the beginning of the line. Pressing the <SKIPUP> key skips over all the characters in the template up to the character pressed after the <SKIPUP> key:

```
1:*This is a sample file  
<SKIPUP>p 1:*_
```

The cursor position does not change. To see how much of the line has been skipped over, press the <COPYALL> key to copy the template. This moves the cursor beyond the last character of the line:

```
1:*This is a sample file:  
<SKIPUP>p 1:_  
<COPYALL> 1:*_ple file._
```

KEY

<VOID>

PURPOSE

Quits input and empties the command line.

COMMENTS

Pressing the <VOID> key empties the command line, but it leaves the template unchanged. <VOID> also prints a back slash (\), carriage return, and line feed, and turns insert mode off. The cursor (indicated by the underline) is positioned at the beginning of the line. Pressing the <COPYALL> key copies the template to the command line and the command line appears as it was before <VOID> was pressed.

Example:

Assume that the screen shows:

```
1:*This is a sample file.  
1:_
```

At the beginning of the editing session, the cursor (indicated by the underline) is positioned at the beginning of the line. Assume that you want to replace the line with "Sample File":

```
1:*This is a sample file.  
1_:*Sample File_
```

To cancel the line you just entered (Sample File), and to keep "This is a sample file.", press <VOID>. Notice that a backslash appears on the Sample File line to tell you it has been cancelled.

```
1:*This is a sample file.  
<VOID> 1_:*Sample File\  
1:_
```

Press <RETURN> to keep the original line, or to perform any other editing functions. If <COPYALL> is pressed, the original template is copied to the command line:

```
<COPYALL> 1: This is a sample file._
```

KEY
 <INSERT>

PURPOSE
 Enters/exits insert mode.

COMMENTS
 Pressing the <INSERT> key causes EDLIN to enter and exit insert mode. The current cursor position in the template is not changed. The cursor does move as each character is inserted. However, when you have finished inserting characters, the cursor will be positioned at the same character as it was before the insertion began. Thus, characters are inserted in front of the character to which the cursor points.

Example:
 Assume that the screen shows:

```
1:*This is a sample file.  
1:*_
```

At the beginning of the editing session, the cursor (indicated by the underline) is positioned at the beginning of the line. Assume that you press the <COPYUP> and "f" keys:

```
1:*This is a sample file  
<COPYUP>f 1:*This is a sample _
```

Now press the <INSERT> key and insert the characters "edit" and a space:

```
1:*This is a sample file.  
<COPYUP>f 1:*This is a sample  
<INSERT>edit 1:*This is a sample edit _
```

If you now press the <COPYALL> key, the rest of the template is copied to the line:

```
1:*This is a sample edit  
<COPYALL> 1:*This is a sample edit file._
```

If you pressed the <RETURN> key, the remainder of the template would be truncated, and the command line would end at the end of the insert:

```
<INSERT>edit <RETURN> 1:*This is a sample edit _
```

To exit insert mode, simple press the <INSERT> key again.

KEY

<REPLACE>

PURPOSE

Enters replace mode.

COMMENTS

Pressing the <REPLACE> key causes EDLIN to exit insert mode and to enter replace mode. All the characters you type will overstrike and replace characters in the template. When you start to edit a line, replace mode is in effect. If the <RETURN> key is pressed, the remainder of the template will be deleted.

Example:

Assume that the screen shows:

```
1:*This is a sample file.  
1:*
```

At the beginning of the editing session, the cursor (indicated by the underline) is positioned at the beginning of the line. Assume that you then press <COPYUP>m, <INSERT>lary, <REPLACE> tax, and then <COPYALL>:

```
1:*This is a sample file.  
<COPYUP>m 1:*This is a sa  
<INSERT>lary 1:*This is a salary_  
<REPLACE> tax 1:*This is a salary_tax_  
<COPYALL> 1:*This is a salary tax_file._
```

Notice that you inserted "lary" and replaced "mple" with "tax". If you type characters that extend beyond the length of the template, the remaining characters in the template will be automatically appended when you press <COPYALL>.

KEY
 <NEWLINE>

PURPOSE
 Creates a new template.

COMMENTS
 Pressing the <NEWLINE> key copies the current command line to the template. The contents of the old template are deleted. Pressing <NEWLINE> outputs an @ ("at sign" character), a carriage return, and a line feed. The command line is also emptied and insert mode is turned off.

NOTE

<NEWLINE> performs the same function as the <VOID> key, except that the template is changed and an @ ("at sign" character) is printed instead of a \ (backslash).

Example:

Assume that the screen shows:

```
l:*This is a sample file.  
l:_
```

At the beginning of the editing session, the cursor (indicated by the underline) is positioned at the beginning of the line. Assume that you enter <COPYUP>m, <INSERT>lary, <REPLACE> tax, and then <COPYALL>:

```
l:*This is a sample file.  
<COPYUP>m l:*This is a sa  
<INSERT>lary l:*This is a salary_  
<REPLACE> tax l:*This is a salary tax_  
<COPYALL> l:*This is a salary tax_file._
```

At this point, assume that you want this line to be the new template, so you press the <NEWLINE>key:

<NEWLINE>1:*This is a salary tax file.@

The @ indicates that this new line is now the new template. Additional editing can be done using the new template.

7.4 COMMAND INFORMATION

EDLIN commands perform editing functions on lines of text. The following list contains information you should read before you use EDLIN commands.

1. Pathnames are acceptable as options to commands. For example, typing EDLIN \BIN\USER\JOE\TEXT.TXT will allow you to edit the TEXT.TXT file in the subdirectory JOE.
2. You can reference line numbers relative to the current line (the line with the asterisk). Use a minus sign with a number to indicate lines before the current line. Use a plus sign with a number to indicate lines after the current line.

Example:

-10,+10L

This command lists 10 lines before the current line, the current line, and 10 lines after the current line.

3. Multiple commands may be issued on one command line. When you issue a command to edit a single line using a line number (<line>), a semicolon must separate commands on the line. Otherwise, one command may follow another without any special separators. In the case of a Search or Replace command, the <string> may be ended by a <CONTROL-Z> instead of a <RETURN>.

Examples:

The following command line edits line 15 and then displays lines 10 through 20 on the screen.

15;-5,+5L

The command line in the next example searches for "This string" and then displays 5 lines before and 5 lines after the line containing the matched string. If the search fails, then the displayed lines are those line numbers relative to the current line.

SThis string<CONTROL-Z>-5,+L

4. You can type EDLIN commands with or without a space between the line number and command. For example, to delete line 6, the command 6D is the same as 6 D.
5. It is possible to insert a control character (such as CONTROL-C) into text by using the quote character CONTROL-V before it while in insert mode. CONTROL-V tells MS-DOS to recognize the next capital letter typed as a control character. It is also possible to use a control character in any of the string arguments of Search or Replace by using the special quote character. For example:

S<CONTROL-V>Z
will find the first occurrence
of CONTROL-Z in a file

R<CONTROL-V>Z<CONTROL-Z>foo
will replace all occurrences
of CONTROL-Z in a file by foo

S<CONTROL-V>C<CONTROL-Z>bar
will replace all occurrences
of CONTROL-C by bar

It is possible to insert CONTROL-V into the text by typing CONTROL-V-V.

6. The CONTROL-Z character ordinarily tells EDLIN, "This is the end of the file." If you have CONTROL-Z characters elsewhere in your file, you must tell EDLIN that these other control characters do not mean "End of File." Use the -B switch to tell EDLIN to ignore any CONTROL-Z characters in the file and to show you the entire file.

The EDLIN commands are summarized in the following table. They are also described in further detail following the description of command options.

Table 7.2 EDLIN Commands

Command	Purpose
<line>	Edits line no.
A	Appends lines
C	Copies lines
D	Deletes lines
E	Ends editing
I	Inserts lines
L	Lists text
M	Moves lines
P	Pages text
Q	Quits editing
R	Replaces lines
S	Searches text
T	Transfers text
W	Writes lines

7.4.1 Command Options

Several EDLIN commands accept one or more options. The effect of a command option varies, depending on with which command it is used. The following list describes each option.

<line> <line> indicates a line number that you type. Line numbers must be separated by a comma or a space from other line numbers, other options, and from the command.

<line> may be specified one of three ways:

Number Any number less than 65534. If a number larger than the largest existing line number is specified, then <line> means the line after the last line number.

Period (.) If a period is specified for <line>, then <line> means the current line number. The current line is the last line edited, and is not necessarily the last line displayed. The current line is marked on your screen by an asterisk (*) between the line number and the first character.

Pound (#) The pound sign indicates the line after the last line number. If you specify # for <line>, this has the same effect as specifying a number larger than the last line number.

<RETURN> A carriage return entered without any of the <line> specifiers listed above directs EDLIN to use a default value appropriate to the command.

? The question mark option directs EDLIN to ask you if the correct string has been found. The question mark is used only with the Replace and Search commands. Before continuing, EDLIN waits for either a "y" or <RETURN> for a yes response, or for any other key for a no response.

<string> <string> represents text to be found, to be replaced, or to replace other text. The <string> option is used only with the Search and Replace commands. Each <string> must be ended by a <CONTROL-Z> or a <RETURN> (see the Replace command for details). No spaces should be left between strings or between a string and its command letter, unless you want those spaces to be part of the string.

7.5 EDLIN COMMANDS

The following pages describe EDLIN editing commands.

NAME

Append

PURPOSE

Adds the specified number of lines from disk to the file being edited in memory. The lines are added at the end of lines that are currently in memory.

SYNTAX

[<n>]A

COMMENTS

This command is meaningful only if the file being edited is too large to fit into memory. As many lines as possible are read into memory for editing when you start EDLIN.

To edit the remainder of the file that will not fit into memory, lines that have already been edited must be written to disk. Then you can load unedited lines from disk into memory with the Append command. Refer to the Write command in this chapter for information on how to write edited lines to disk.

NOTES

1. If you do not specify the number of lines to append, lines will be appended to memory until available memory is 3/4 full. No action will be taken if available memory is already 3/4 full.

2. The message "End of input file" is displayed when the Append command has read the last line of the file into memory.

NAME**Copy****PURPOSE**

Copies a range of lines to a specified line number. The lines can be copied as many times as you want by using the <count> option.

SYNTAX

[<line>],[<line>],<line>,[<count>]C

COMMENTS

If you do not specify a number in <count>, EDLIN copies the lines one time. If the first or the second <line> are omitted, the default is the current line. The file is renumbered automatically after the copy.

The line numbers must not overlap or you will get an "Entry error" message. For example, 3,20,15C would result in an error message.

Examples:

Assume that the following file exists and is ready to edit:

- 1: This is a sample file
- 2: used to show copying lines.
- 3: See what happens when you use
- 4: the Copy command
- 5: (the C command)
- 6: to copy text in your file.

You can copy this entire block of text by issuing the following command:

1,6,7C

The result is:

```
1: This is a sample file
2: used to show copying lines.
3: See what happens when you use
4: the Copy command
5: (the C command)
6: to copy text in your file.
7: This is a sample file
8: used to show copying lines.
9: See what happens when you use
10: the Copy command
11: (the C command)
12: to copy text in your file.
```

If you want to place the text within other text, the third <line> option should specify the line before which you want the copied text to appear. For example, assume that you want to copy lines and insert them within the following file:

```
1: This is a sample file
2: used to show copying lines.
3: See what happens when you use
4: the Copy command
5: (the C command)
6: to copy text in your file.
7: You can also use COPY
8: to copy lines of text
9: to the middle of your file.
10: End of sample file.
```

The command 3,6,9C results in the following file:

```
1: This is a sample file
2: used to show copying lines.
3: See what happens when you use
4: the Copy command
5: (the C command)
6: to copy text in your file.
7: You can also use COPY
8: to copy lines of text
9: to the middle of your file.
10: See what happens when you use
11: the Copy command
12: (the C command)
13: to copy text in your file.
14: End of sample file.
```

NAME

Delete

PURPOSE

Deletes a specified range of lines in a file.

SYNTAX

[<line>][,<line>]D

COMMENTS

If the first <line> is omitted, that option will default to the current line (the line with the asterisk next to the line number). If the second <line> is omitted, then just the first <line> will be deleted. When lines have been deleted, the line immediately after the deleted section becomes the current line and has the same line number as the first deleted <line> had before the deletion occurred.

Examples:

Assume that the following file exists and is ready to edit:

```
1: This is a sample file
2: used to show dynamic line numbers.
3: See what happens when you use
4: Delete and Insert
.
.
.
25: (the D and I commands)
26: to edit the text
27:*in your file.
```

To delete multiple lines, type <line>,<line>D:

5,24D

The result is:

```
1: This is a sample file
2: used to show dynamic line numbers.
3: See what happens when you use
4: Delete and Insert
5: (the D and I commands)
6: to edit text
7:*in your file.
```

To delete a single line, type:

6D

The result is:

1: This is a sample file
2: used to show dynamic line numbers.
3: See what happens when you use
4: Delete and Insert
5: (the D and I commands)
6:*in your file.

Next, delete a range of lines from the following file:

1: This is a sample file
2: used to show dynamic line numbers.
3:*See what happens when you use
4: Delete and Insert
5: (the D and I commands)
6: to edit text
7: in your file.

To delete a range of lines beginning with the current line, type:

,6D

The result is:

1: This is a sample file
2: used to show dynamic line numbers.
3:*in your file.

Notice that the lines are automatically renumbered.

NAME

Edit

PURPOSE

Edits line of text.

SYNTAX

[<line>]

COMMENTS

When a line number is typed, EDLIN displays the line number and text; then, on the line below, EDLIN reprints the line number. The line is now ready for editing. You may use any of the EDLIN editing commands to edit the line. The existing text of the line serves as the template until the <RETURN> key is pressed.

If no line number is typed (that is, if only the <RETURN> key is pressed), the line after the current line (marked with an asterisk (*)) is edited. If no changes to the current line are needed and the cursor is at the beginning or end of the line, press the <RETURN> key to accept the line as is.

WARNING

If the <RETURN> key is pressed while the cursor is in the middle of the line, the remainder of the line is deleted.

Example:

Assume that the following file exists and is ready to edit:

```
1: This is a sample file.  
2: used to show  
3: the editing of line  
4: *four.
```

To edit line 4, type:

The contents of the line are displayed with a cursor below the line:

```
4:* four.  
4:_
```

Now, using the <COPYALL> special editing key, type:

```
<INSERT>number 4: number  
<COPYALL><RETURN> 4: number-four.  
5:_
```

NAME

End

PURPOSE

Ends the editing session.

SYNTAX

E

COMMENTS

This command saves the edited file on disk, renames the original input file <filename>.BAK, and then exits EDLIN. If the file was created during the editing session, no .BAK file is created.

The E command takes no options. Therefore, you cannot tell EDLIN on which drive to save the file. The drive you want to save the file on must be selected when the editing session is started. If the drive is not selected when EDLIN is started, the file will be saved on the disk in the default drive. It will still be possible to COPY the file to a different drive using the MS-DOS COPY command.

You must be sure that the disk contains enough free space for the entire file. If the disk does not contain enough free space, the write will be aborted and the edited file lost, although part of the file might be written out to the disk.

Example:

E<RETURN>

After execution of the E command, the MS-DOS default drive prompt (for example, A:) is displayed.

NAME**Insert****PURPOSE**

Inserts text immediately before the specified <line>.

SYNTAX

[<line>] I

COMMENTS

If you are creating a new file, the I command must be given before text can be typed (inserted). Text begins with line number 1. Successive line numbers appear automatically each time <RETURN> is pressed.

EDLIN remains in insert mode until <CONTROL-C> is typed. When the insert is completed and insert mode has been exited, the line immediately following the inserted lines becomes the current line. All line numbers following the inserted section are incremented by the number of lines inserted.

If <line> is not specified, the default will be the current line number and the lines will be inserted immediately before the current line. If <line> is any number larger than the last line number, or if a pound sign (#) is specified as <line>, the inserted lines will be appended to the end of the file. In this case, the last line inserted will become the current line.

Examples:

Assume that the following file exists and is ready to edit:

```
1: This is a sample file
2: used to show dynamic line numbers.
3: See what happens when you use
4: Delete and Insert
5: (the D and I commands)
6: to edit text
7: *in your file.
```

To insert text before a specific line that is not the current line, type <line>I:

7I

The result is:

7:_

Now, type the new text for line 7:

7: and renumber lines

Then to end the insertion, press <CONTROL-Z> on the next line:

8: <CONTROL-Z>

Now type L to list the file. The result is:

1: This is a sample file
2: used to show dynamic line numbers.
3: See what happens when you use
4: Delete and Insert
5: (the D and I commands)
6: to edit text
7: and renumber lines
8: *in your file.

To insert lines immediately before the current line, type:

I

The result is:

8: _

Now, insert the following text and terminate with a <CONTROL-Z> on the next line:

8: so they are consecutive
9: <CONTROL-Z>

Now to list the file and see the result, type L:

The result is:

```
1: This is a sample file
2: used to show dynamic line numbers.
3: See what happens when you use
4: Delete and Insert
5: (the D and I commands)
6: to edit text
7: and renumber lines
8: so they are consecutive
9:*in your file.
```

To append new lines to the end of the file,
type:

```
10I
```

This produces the following:

```
10: _
```

Now, type the following new lines:

```
10: The insert command can place new lines
11: in the file; there's no problem
12: because the line numbers are dynamic;
13: they'll go all the way to 65533.
```

End the insertion by pressing <CONTROL-Z> on
line 14. The new lines will appear at the end
of all previous lines in the file. Now type
the list command, L:

The result is:

```
1: This is a sample file
2: used to show dynamic line numbers.
3: See what happens when you use
4: Delete and Insert
5: (the D and I commands)
6: to edit text
7: and renumber lines
8: so they are consecutive
9: in your file.
10: The insert command can place new lines
11: in the file; there's no problem
12: because the line numbers are dynamic;
13: they'll go all the way to 65533.
```

NAME**List****PURPOSE**

Lists a range of lines, including the two lines specified.

SYNTAX

[<line>][,<line>]L

COMMENTS

Default values are provided if either one or both of the options are omitted. If you omit the first option, as in:

,<line>L

the display will start 11 lines before the current line and end with the specified <line>. The beginning comma is required to indicate the omitted first option.

NOTE

If the specified <line> is more than 11 lines before the current line, the display will be the same as if you omitted both options.

If you omit the second option, as in

<line>L

23 lines will be displayed, starting with the specified <line>.

If you omit both parameters, as in

L

23 lines will be displayed--the 11 lines before the current line, the current line, and the 11 lines after the current line. If there are less than 11 lines before the current line, more than 11 lines after the current line will be displayed to make a total of 23 lines.

Examples:

Assume that the following file exists and is ready to edit:

```
1: This is a sample file
2: used to show dynamic line numbers.
3: See what happens when you use
4: Delete and Insert
5: (the D and I commands)
.
.
.
15:*The current line contains an asterisk.
.
.
.
26: to edit text
27: in your file.
```

To list a range of lines without reference to the current line, type <line>,<line>L:

2,5L

The result is:

```
2: used to show dynamic line numbers.
3: See what happens when you use
4: Delete and Insert
5: (the D and I commands)
```

To list a range of lines beginning with the current line, type ,<line> L:

,26L

The result is:

```
15:*The current line contains an asterisk.
.
.
.
26: to edit text
```

To list a range of 23 lines centered around the current line, type only L:

L

The result is:

- 4: Delete and Insert
- 5: (the D and I commands)
- .
- .
- .
- 13: The current line is listed in the middle.
- 14: The current line remains unchanged.
- 15: *The current line contains an asterisk.
- .
- .
- .
- 26: to edit text.

NAME

Move

PURPOSE

Moves a range of text to the line specified.

SYNTAX

[<line>],[<line>],<line>M

COMMENTS

Use the Move command to move a block of text (from the first <line> to the second <line>) to another location in the file. The lines are renumbered according to the direction of the move. For example,

,+25,100M

moves the text from the current line plus 25 lines to line 100. If the line numbers overlap, EDLIN will display an "Entry error" message.

To move lines 20-30 to line 100, type:

20,30,100M

NAME

Page

PURPOSE

Pages through a file 23 lines at a time.

SYNTAX

[<line>] [,<line>]P

COMMENTS

If the first <line> is omitted, that number will default to the current line plus one. If the second <line> is omitted, 23 lines will be listed. The new current line becomes the last line displayed and is marked with an asterisk.

NAME

Quit

PURPOSE

Quits the editing session, does not save any editing changes, and exits to the MS-DOS operating system.

SYNTAX

Q

COMMENTS

EDLIN prompts you to make sure you don't want to save the changes.

Type Y if you want to quit the editing session. No editing changes are saved and no .BAK file is created. Refer to the End command in this chapter for information about the .BAK file.

Type N or any other character except Y if you want to continue the editing session.

NOTE

When started, EDLIN erases any previous copy of the file with an extension of .BAK to make room to save the new copy. If you reply Y to the "Abort edit (Y/N)?" message, your previous backup copy will no longer exist.

Example: Q
Abort edit (Y/N)?Y<RETURN>
A: _

NAME

Replace

PURPOSE

Replaces all occurrences of a string of text in the specified range with a different string of text or blanks.

SYNTAX

[<line>][,<line>][?]R<string1><CONTROL-Z><string2>

COMMENTS

As each occurrence of <string1> is found, it is replaced by <string2>. Each line in which a replacement occurs will be displayed. If a line contains two or more replacements of <string1> with <string2>, then the line will be displayed once for each occurrence. When all occurrences of <string1> in the specified range are replaced by <string2>, the R command terminates and the asterisk prompt reappears.

If a second string is to be given as a replacement, then <string1> must be separated from <string2> with a <CONTROL-Z>. <String2> must also be ended with a <CONTROL-Z><RETURN> combination or with a simple <RETURN>.

If <string1> is omitted, then Replace will take the old <string1> as its value. If there is no old <string1>, i.e., this is the first replace done, then the replacement process will be terminated immediately. If <string2> is omitted, then <string1> may be ended with a <RETURN>. If the first <line> is omitted in the range argument (as in ,<line>) then the first <line> will default to the line after the current line. If the second <line> is omitted (as in <line> or <line>,), the second <line> will default to #. Therefore, this is the same as <line>,#. Remember that # indicates the line after the last line of the file.

If <string1> is ended with a <CONTROL-Z> and there is no <string2>, <string2> will be taken

as an empty string and will become the new replace string. For example,

```
R<string2><CONTROL-Z><RETURN>
```

will delete occurrences of <string1>, but

```
R<string1><return>      and  
R<RETURN>
```

will replace <string1> by the old <string2> and the old <string1> with the old <string2>, respectively. Note that "old" here refers to a previous string specified either in a Search or a Replace command.

If the question mark (?) option is given, the Replace command will stop at each line with a string that matches <string1>, display the line with <string2> in place, and then display the prompt "O.K.?". If you press "y" or the <RETURN> key, then <string2> will replace <string1>, and the next occurrence of <string1> will be found. Again, the "O.K.?" prompt will be displayed. This process will continue until the end of the range or until the end of the file. After the last occurrence of <string1> is found, EDLIN displays the asterisk prompt.

If you press any key besides "y" or <RETURN> after the "O.K.?" prompt, the <string1> will be left as it was in the line, and Replace will go to the next occurrence of <string1>. If <string1> occurs more than once in a line, each occurrence of <string1> will be replaced individually, and the "O.K.?" prompt will be displayed after each replacement. In this way, only the desired <string1> will be replaced, and you can prevent unwanted substitutions.

Examples:

Assume that the following file exists and is ready for editing:

```
1: This is a sample file  
2: used to show dynamic line numbers.  
3: See what happens when you use  
4: Delete and Insert  
5: (the D and I commands)  
6: to edit text  
7: in your file.  
8: The insert command can place new lines
```

```
9: in the file; there's no problem  
10: because the line numbers are dynamic;  
11: they'll go all the way to 65533.
```

To replace all occurrences of <string1> with <string2> in a specified range, type:

```
2,12 Rand<CONTROL-Z>or<RETURN>
```

The result is:

```
4: Delete or Insert  
5: (the D or I commands)  
8: The insert commor can place new lines
```

Note that in the above replacement, some unwanted substitutions have occurred. To avoid these and to confirm each replacement, the same original file can be used with a slightly different command.

In the next example, to replace only certain occurrences of the first <string> with the second <string>, type:

```
2? Rand<CONTROL-Z>or<RETURN>
```

The result is:

```
4: Delete or Insert  
O.K.? Y  
5: (The D or I commands)  
O.K.? Y  
5: (The D or I commands)  
O.K.? N  
8: The insert commor can place new lines  
O.K.? N  
*-
```

Now, type the List command (L) to see the result of all these changes:

```
•  
•  
4: Delete or Insert  
5: (The D or I commands)  
•  
8: The insert command can place new lines  
•  
•
```

NAME

Search

PURPOSE

Searches the specified range of lines for a specified string of text.

SYNTAX

[<line>][,<line>] [?] S<string><RETURN>

COMMENTS

The <string> must be ended with a <RETURN>. The first line that matches <string> is displayed and becomes the current line. If the question mark option is not specified, the Search command will terminate when a match is found. If no line contains a match for <string>, the message "Not found" will be displayed.

If the question mark option (?) is included in the command, EDLIN will display the first line with a matching string; it will then prompt you with the message "O.K.?". If you press either the "Y" or <RETURN> key, the line will become the current line and the search will terminate. If you press any other key, the search will continue until another match is found, or until all lines have been searched (and the "Not found" message is displayed).

If the first <line> is omitted (as in ,<line> S<string>), the first <line> will default to the line after the current line. If the second <line> is omitted (as in <line> S<string> or <line>, S<string>), the second <line> will default to # (line after last line of file), which is the same as <line>,# S<string>. If <string> is omitted, Search will take the old string if there is one. (Note that "old" here refers to a string specified in a previous Search or Replace command.) If there is not an old string (i.e., no previous search or replace has been done), the command will terminate immediately.

Examples:

Assume that the following file exists and is ready for editing:

```
1: This is a sample file
2: used to show dynamic line numbers.
3: See what happens when you use
4: Delete and Insert
5: (the D and I commands)
6: to edit text
7: in your file.
8: The insert command can place new lines
9: in the file; there's no problem
10: because the line numbers are dynamic;
11: *they'll go all the way to 65533.
```

To search for the first occurrence of the string "and", type

```
2,12 Sand<RETURN>
```

The following line is displayed:

```
4: Delete and Insert
```

To get the "and" in line 5, modify the search command by typing:

```
<SKIP1><COPYALL>,12 Sand<RETURN>
```

The search then continues from the line after the current line (line 4), since no first line was given. The result is:

```
5: (the D and I commands)
```

To search through several occurrences of a string until the correct string is found, type:

```
1, ? Sand
```

The result is:

```
4: Delete and Insert
O.K.?_
```

If you press any key (except "Y" or <RETURN>), the search continues, so type "N" here:

```
O.K.? N
```

Continue:

5: (the D and I commands)
O.K.?_

Now press "Y" to terminate the search:

O.K.? Y
*
-

To search for string XYZ without the verification (O.K.?), type:

SXYZ

EDLIN will report a match and will continue to search for the same string when you issue the S command:

S

EDLIN reports another match.

S

EDLIN reports the string is not found.

Note that <string> defaults to any string specified by a previous Replace or Search command.

NAME**Transfer****PURPOSE**

Inserts (merges) the contents of <filename> into the file currently being edited at <line>. If <line> is omitted, then the current line will be used.

SYNTAX**[<line>]T<filename>****COMMENTS**

This command is useful if you want to put the contents of a file into another file or into the text you are typing. The transferred text is inserted at the line number specified by <line> and the lines are renumbered.

NAME

Write

PURPOSE

Writes a specified number of lines to disk from the lines that are being edited in memory. Lines are written to disk beginning with line number 1.

SYNTAX

[<n>]W

COMMENTS

This command is meaningful only if the file you are editing is too large to fit into memory. When you start EDLIN, EDLIN reads lines into memory until memory is 3/4 full.

To edit the remainder of your file, you must write edited lines in memory to disk. Then you can load additional unedited lines from disk into memory by using the Append command.

NOTE

If you do not specify the number of lines, lines will be written until memory is 3/4 full. No action will be taken if available memory is already more than 3/4 full. All lines are renumbered, so that the first remaining line becomes line number 1.

7.6 ERROR MESSAGES

When EDLIN finds an error, one of the following error messages is displayed:

Cannot edit .BAK file--rename file

Cause: You attempted to edit a file with a filename extension of .BAK. .BAK files cannot be edited because this extension is reserved for backup copies.

Cure: If you need the .BAK file for editing purposes, you must either RENAME the file with a different extension; or COPY the .BAK file and give it a different filename extension.

No room in directory for file

Cause: When you attempted to create a new file, either the file directory was full or you specified an illegal disk drive or an illegal filename.

Cure: Check the command line that started EDLIN for illegal filename and illegal disk drive entries. If the command is no longer on the screen and if you have not yet typed a new command, the EDLIN start command can be recovered by pressing the <COPYALL> key.

If this command line contains no illegal entries, run the CHKDSK program for the specified disk drive. If the status report shows that the disk directory is full, remove the disk. Insert and format a new disk.

Entry Error

Cause: The last command typed contained a syntax error.

Cure: Retype the command with the correct syntax and press <RETURN>.

Line too long

Cause: During a Replace command, the string given as the replacement caused the line to expand beyond the limit of 253 characters. EDLIN aborted the Replace command.

Cure: Divide the long line into two lines, then try the Replace command twice.

Disk Full--file write not completed

Cause: You gave the End command, but the disk did not contain enough free space for the whole file. EDLIN aborted the E command and returned you to the operating system. Some of the file may have been written to the disk.

Cure: Only a portion (if any) of the file has been saved. You should probably delete that portion of the file and restart the editing session. The file will not be available after this error. Always be sure that the disk has sufficient free space for the file to be written to disk before you begin your editing session.

Incorrect DOS version

Cause: You attempted to run EDLIN under a version of MS-DOS that was not 2.0 or higher.

Cure: You must make sure that the version of MS-DOS that you are using is 2.0 or higher.

Invalid drive name or file

Cause: You have not specified a valid drive or filename when starting EDLIN.

Cure: Specify the correct drive or filename.

Filename must be specified

Cause: You did not specify a filename when you started EDLIN.

Cure: Specify a filename.

Invalid Parameter

Cause: You specified a switch other than -B when starting EDLIN.

Cure: Specify the -B switch when you start EDLIN.

Insufficient memory

Cause: There is not enough memory to run EDLIN.

Cure: You must free some memory by writing files to disk or by deleting files before restarting EDLIN.

File not found

Cause: The filename specified during a Transfer command was not found.

Cure: Specify a valid filename when issuing a Transfer command.

Must specify destination number

Cause: A destination line number was not specified for a Copy or Move command.

Cure: Reissue the command with a destination line number.

Not enough room to merge the entire file

Cause: There was not enough room in memory to hold the file during a Transfer command.

Cure: You must free some memory by writing some files to disk or by deleting some files before you can transfer this file.

File creation error

Cause: The EDLIN temporary file cannot be created.

Cure: Check to make sure that the directory has enough space to create the temporary file. Also, make sure that the file dos not have the same name as a subdirectory in the directory where the file to be edited is located.

CHAPTER 8
FILE COMPARISON UTILITY (FC)

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8.1 INTRODUCTION

It is sometimes useful to compare files on your disk. If you have copied a file and later want to compare copies to see which one is current, you can use the MS-DOS File Comparison Utility (FC).

The File Comparison Utility compares the contents of two files. The differences between the two files can be output to the console or to a third file. The files being compared may be either source files (files containing source statements of a programming language); or binary (files output by the MACRO-86 assembler, the MS-LINK Linker utility, or by a Microsoft high-level language compiler).

The comparisons are made in one of two ways: on a line-by-line or a byte-by-byte basis. The line-by-line comparison isolates blocks of lines that are different between the two files and prints those blocks of lines. The byte-by-byte comparison displays the bytes that are different between the two files.

8.1.1 Limitations On Source Comparisons

FC uses a large amount of memory as buffer (storage) space to hold the source files. If the source files are larger than available memory, FC will compare what can be loaded into the buffer space. If no lines match in the portions of the files in the buffer space, FC will display only the message:

FILES ARE DIFFERENT

For binary files larger than available memory, FC compares both files completely, overlaying the portion in memory with the next portion from disk. All differences are output in the same manner as those files that fit completely in memory.

8.2 FILE SPECIFICATIONS

All file specifications use the following syntax:

[d:]<filename>[<.ext>]

where: d: is the letter designating a disk drive. If the drive designation is omitted, FC defaults to the operating system's (current) default drive.

filename is a one- to eight-character name of the file.

.ext is a one- to three-character extension to the filename.

8.3 HOW TO USE FC

The syntax of FC is as follows:

```
FC [/# /B /W /C] <filename1> <filename2>
```

FC matches the first file (filename1) against the second (filename2) and reports any differences between them. Both filenames can be pathnames. For example,

```
FC B:\FOO\BAR\FILE1.TXT \BAR\FILE2.TXT
```

FC takes FILE1.TXT in the \FOO\BAR directory of disk B and compares it with FILE2.TXT in the \BAR directory. Since no drive is specified for filename2, FC assumes that the \BAR directory is on the disk in the default drive.

8.4 FC SWITCHES

There are four switches that you can use with the File Comparison Utility:

/B Forces a binary comparison of both files. The two files are compared byte-to-byte, with no attempt to re-synchronize after a mismatch. The mismatches are printed as follows:

```
--ADDRS----F1----F2-
xxxxxxx yy zz
```

(where xxxxxxxx is the relative address of the pair of bytes from the beginning of the file). Addresses start at 00000000; yy and zz are the mismatched bytes from file1 and file2, respectively. If one of the files contains less data than the other, then a message is printed out. For example, if file1 ends before file2, then FC displays:

```
***Data left in F2***
```

/# # stands for a number from 1 to 9. This switch specifies the number of lines required to match for the files to be considered as matching again after a difference has been found. If this switch is not specified, it defaults to 3. This switch is used only in source comparisons.

/W Causes FC to compress whites (tabs and spaces) during the comparison. Thus, multiple contiguous whites in any line will be considered as a single white space. Note that although FC compresses whites, it does not ignore them. The two exceptions are beginning and ending whites in a line, which are ignored. For example (note that an underscore represents a white)

More_data_to_be_found

will match with

More_data_to_be_found

and with

More_data_to_be_found

but will not match with

Moredata_to_be_found

This switch is used only in source comparisons.

/C Causes the matching process to ignore the case of letters. All letters in the files are considered uppercase letters. For example,

Much_MORE_data_IS_NOT_FOUND

will match

much_more_data_is_not_found

If both the /W and /C options are specified, then FC will compress whites and ignore case. For example,

DATA_was_found

will match:

data_was_found

This switch is used only in source comparisons.

8.5 DIFFERENCE REPORTING

The File Comparison Utility reports the differences between the two files you specify by displaying the first filename, followed by the lines that differ between the files, followed by the first line to match in both files. FC then displays the name of the second file followed by the lines that are different, followed by the first line that matches. The default for the number of lines to match between the files is 3. (If you want to change this default, specify the number of lines with the /# switch.) For example,

```
...
...
-----<filename1>
<difference>
<1st line to match file2 in file1>

-----<filename2>
<difference>
<1st line to match file1 in file2>

-----
...
...
```

FC will continue to list each difference.

If there are too many differences (involving too many lines), the program will simply report that the files are different and stop.

If no matches are found after the first difference is found, FC will display:

```
*** Files are different ***
```

and will return to the MS-DOS default drive prompt (for example, A:).

8.6 REDIRECTING FC OUTPUT TO A FILE

The differences and matches between the two files you specify will be displayed on your screen unless you redirect the output to a file. This is accomplished in the same way as MS-DOS command redirection (refer to Chapter 4, Learning About Commands).

To compare File1 and File2 and then send the FC output to DIFFER.TXT, type:

```
FC File1 File2 >DIFFER.TXT
```

The differences and matches between File1 and File2 will be put into DIFFER.TXT on the default drive.

8.7 EXAMPLES

Example 1

Assume these two ASCII files are on disk:

ALPHA.ASM	BETA.ASM
FILE A	FILE B
<hr/>	
A	A
B	B
C	C
D	G
E	H
F	I
G	J
H	1
I	2
M	P
N	Q
O	R
P	S
Q	T
R	U
S	V
T	4
U	5
V	W
W	X
X	Y
Y	Z
Z	

To compare the two files and display the differences on the terminal screen, type:

```
FC ALPHA.ASM BETA.ASM
```

FC compares ALPHA.ASM with BETA.ASM and displays the differences on the terminal screen. All other defaults remain intact. (The defaults are: do not use tabs, spaces, or comments for matches, and do a source comparison on the two files.)

The output will appear as follows on the terminal screen (the Notes do not appear):

```
-----ALPHA.ASM
```

```
D NOTE: ALPHA file  
E contains defg,  
F BETA contains g.  
G
```

```
-----BETA.ASM
```

```
G
```

```
-----ALPHA.ASM
```

```
M NOTE: ALPHA file  
N contains mno where  
O BETA contains jl2.  
P
```

```
-----BETA.ASM
```

```
J  
1  
2  
P
```

```
-----ALPHA.ASM
```

```
W NOTE: ALPHA file  
contains w where  
-----BETA.ASM BETA contains 45w.
```

```
4  
5  
W
```

Example 2

You can print the differences on the line printer using the same two source files. In this example, four successive lines must be the same to constitute a match.

Type:

```
FC /4 ALPHA.ASM BETA.ASM >PRN
```

The following output will appear on the line printer:

-----ALPHA.ASM

```
D  
E  
F  
G  
H  
I  
M  
N          NOTE: p is the 1st of  
O          a string of 4 matches.  
P
```

-----BETA.ASM

```
G  
H  
I  
J  
L  
2  
P
```

-----ALPHA.ASM

```
W          NOTE: w is the 1st of a  
-----BETA.ASM      string of 4 matches.
```

```
4  
5  
W
```

Example 3

This example forces a binary comparison and then displays the differences on the terminal screen using the same two source files as were used in the previous examples.

Type:

```
FC /B ALPHA.ASM BETA.ASM
```

The /B switch in this example forces binary comparison. This switch and any others must be typed before the filenames in the FC command line. The following display should appear:

--ADDRS--	--F1--	--F2--
00000009	44	47
0000000C	45	48
0000000F	46	49
00000012	47	4A
00000015	48	31
00000018	49	32
0000001B	4D	50
0000001E	4E	51
00000021	4F	52
00000024	50	53
00000027	51	54
0000002A	52	55
0000002D	53	56
00000030	54	34
00000033	55	35
00000036	56	57
00000039	57	58
0000003C	58	59
0000003F	59	5A
00000042	5A	1A

8.8 ERROR MESSAGES

When the File Comparison Utility detects an error, one or more of the following error messages will be displayed:

Incorrect DOS version

You are running FC under a version of MS-DOS that is not 2.0 or higher.

Invalid parameter:<option>

One of the switches that you have specified is invalid.

File not found:<filename>

FC could not find the filename you specified.

Read error in:<filename>

FC could not read the entire file.

Invalid number of parameters

You have specified the wrong number of options on the FC command line.

CHAPTER 9
THE LINKER PROGRAM (MS-LINK)

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9.1 INTRODUCTION

In this chapter you will learn about MS-LINK. It is recommended that you read the entire chapter before you use MS-LINK.

NOTE

If you are not going to compile and link programs, you do not need to read this chapter.

The MS-DOS linker (called MS-LINK) is a program that:

Combines separately produced object modules into one relocatable load module--a program you can run

Searches library files for definitions of unresolved external references

Resolves external cross-references

Produces a listing that shows both the resolution of external references and error messages

9.2 OVERVIEW OF MS-LINK

When you write a program, you write it in source code. This source code is passed through a compiler which produces object modules. The object modules must be passed through the link process to produce machine language that the computer can understand directly. This machine language is in the form required for running programs.

You may wish to link (combine) several programs and run them together. Each of your programs may refer to a symbol that is defined in another object module. This reference is called an external reference.

MS-LINK combines several object modules into one relocatable load module, or Run file (called an .EXE or Executable file). As it combines modules, MS-LINK makes sure that all external references between object modules are defined. LINK can search several library files for definitions of any external references that are not defined in the object modules.

MS-LINK also produces a List file that shows external references resolved, and it also displays any error messages.

MS-LINK uses available memory as much as possible. When available memory is exhausted, MS-LINK creates a temporary disk file named VM.TMP.

Figure 9 illustrates the various parts of the MS-LINK operation.

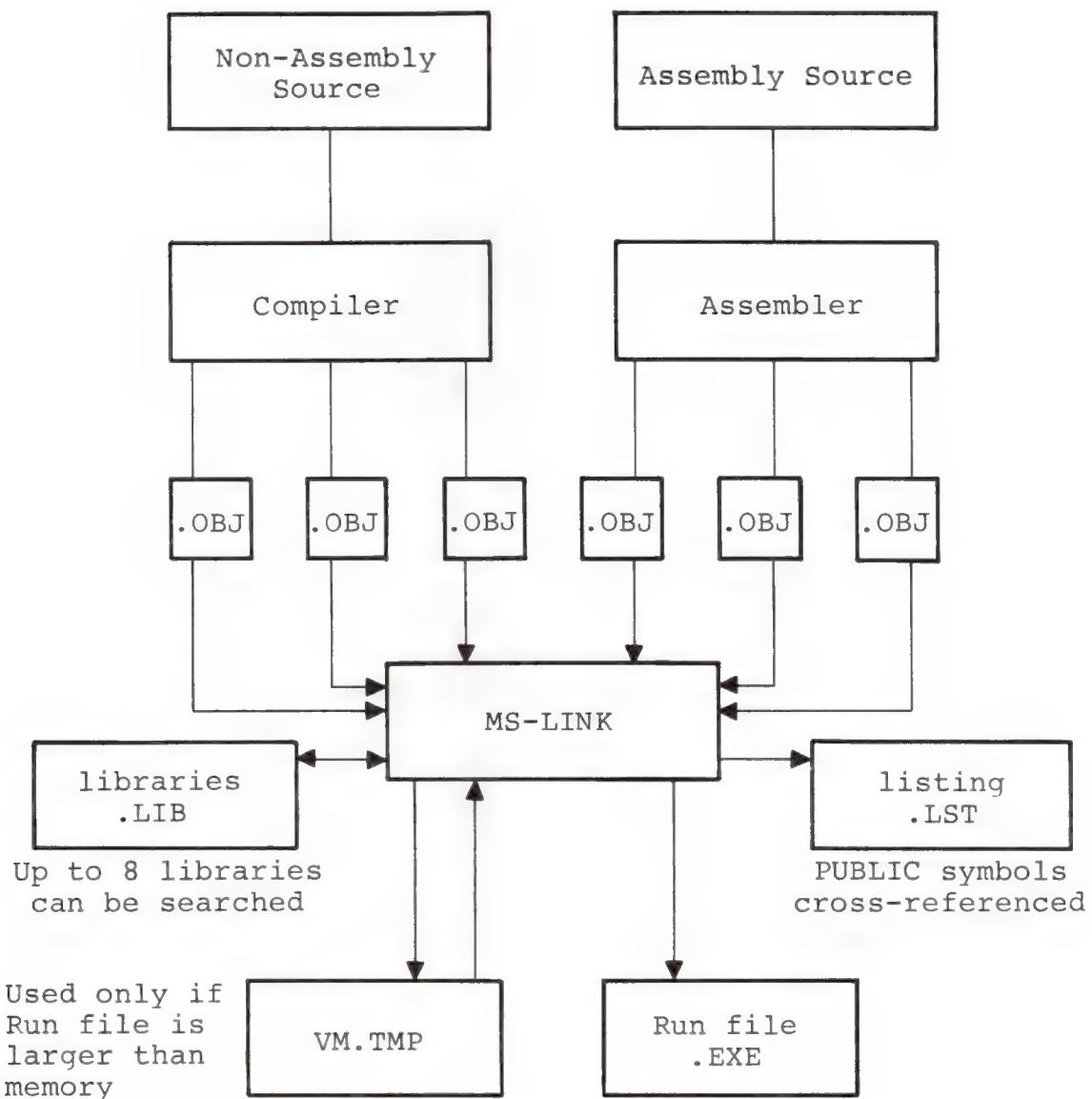
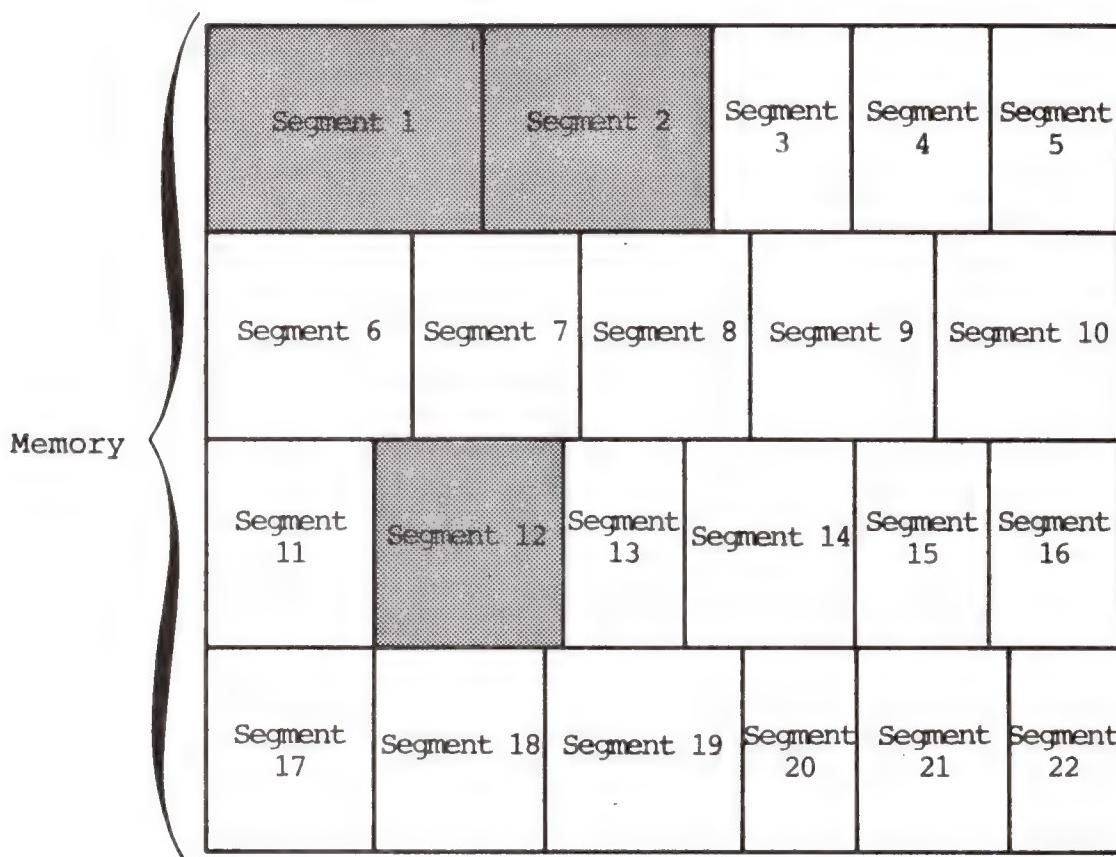


Figure 9. The MS-LINK Operation

9.3 DEFINITIONS YOU'LL NEED TO KNOW

Some of the terms used in this chapter are explained below to help you understand how MS-LINK works. Generally, if you are linking object modules compiled from BASIC, Pascal, or a high-level language, you will not need to know these terms. If you are writing and compiling programs in assembly language, however, you will need to understand MS-LINK and the definitions described below. The chapter MS-LINK in the MS-DOS Programmer's Manual also contains useful information on how MS-LINK works.

In MS-DOS, memory can be divided into segments, classes, and groups. Figure 10 illustrates these concepts.



shaded area = a group (64K bytes addressable)

Figure 10. How Memory Is Divided

Example:

	Segment Name	Segment Class Name
Segment 1	PROG.1	CODE
Segment 2	PROG.2	CODE
Segment 12	PROG.3	DATA

Note that segments 1, 2, and 12 have different segment names but may or may not have the same segment class name. Segments 1, 2, and 12 form a group with a group address of the lowest address of segment 1 (i.e., the lowest address in memory).

Each segment has a segment name and a class name. MS-LINK loads all segments into memory by class name from the first segment encountered to the last. All segments assigned to the same class are loaded into memory contiguously.

During processing, MS-LINK references segments by their addresses in memory (where they are located). MS-LINK does this by finding groups of segments.

A group is a collection of segments that fit within a 64K byte area of memory. The segments do not need to be contiguous to form a group (see illustration). The address of any group is the lowest address of the segments in that group. At link time, MS-LINK analyzes the groups, then references the segments by the address in memory of that group. A program may consist of one or more groups.

If you are writing in assembly language, you may assign the group and class names in your program. In high-level languages (BASIC, COBOL, FORTRAN, Pascal), the naming is done automatically by the compiler.

Refer to the Macro Assembler Manual for information on how to assign group and class names and on how MS-LINK combines and arranges segments in memory.

9.4 FILES THAT MS-LINK USES

MS-LINK:

- Works with one or more input files
- Produces two output files
- May create a temporary disk file
- May be directed to search up to eight library files

For each type of file, the user may give a three-part file specification. The format for MS-LINK file specifications is the same as that of a disk file:

[d:]<filename>[.<ext>]

where: d3: is the drive designation. Permissible drive designations for MS-LINK are A: through O:. The colon is always required as part of the drive designation.

filename is any legal filename of one to eight characters.

.ext is a one- to three-character extension to the filename. The period is always required as part of the extension.

9.4.1 Input File Extensions

If no filename extensions are given in the input (object) file specifications, MS-LINK will recognize the following extensions by default:

.OBJ	Object
.LIB	Library

9.4.2 Output File Extensions

MS-LINK appends the following default extensions to the output (Run and List) files:

.EXE	Run (may not be overridden)
.MAP	List (may be overridden)

9.4.3 VM.TMP (Temporary) File

MS-LINK uses available memory for the link session. If the files to be linked create an output file that exceeds available memory, MS-LINK will create a temporary file, name it VM.TMP, and put it on the disk in the default drive. If MS-LINK creates VM.TMP, it will display the message:

```
VM.TMP has been created.  
Do not change disk in drive, <d:>
```

Once this message has been displayed, you must not remove the disk from the default drive until the link session ends. If the disk is removed, the operation of MS-LINK will be unpredictable, and MS-LINK might display the error message:

```
Unexpected end of file on VM.TMP
```

The contents of VM.TMP are written to the file named following the "Run File:" prompt. VM.TMP is a working file only and is deleted at the end of the linking session.

WARNING

Do not use VM.TMP as a filename for any file. If you have a file named VM.TMP on the default drive and MS-LINK requires the VM.TMP file, MS-LINK will delete the VM.TMP already on disk and create a new VM.TMP. Thus, the contents of the previous VM.TMP file will be lost.

9.5 HOW TO START MS-LINK

MS-LINK requires two types of input: a command to start MS-LINK and responses to command prompts. In addition, six switches control MS-LINK features. Usually, you will type all the commands to MS-LINK on the terminal keyboard. As an option, answers to the command prompts and any switches may be contained in a response file. Command characters can be used to assist you while giving commands to MS-LINK.

MS-LINK may be started in any of three ways. The first method is to type the commands in response to individual prompts. In the second method, you type all commands on the line used to start MS-LINK. To start MS-LINK by the third method, you must create a response file that contains all the necessary commands and tell MS-LINK where that file is when you start MS-LINK.

Summary of Methods to Start MS-LINK

```
=====
Method 1           LINK
Method 2          LINK <filenames>[-switches]
Method 3          LINK @<filespec>
=====
```

9.5.1 Method 1: Prompts

To start MS-LINK with Method 1, type:

LINK

MS-LINK will be loaded into memory. MS-LINK will then display four text prompts that appear one at a time. You answer the prompts to command MS-LINK to perform specific tasks.

At the end of each line, you may type one or more switches, preceded by the switch character (in this case, a forward slash).

The command prompts are summarized below and described in more detail in the Command Prompts section.

PROMPT	RESPONSES
Object Modules [.OBJ]:	List .OBJ files to be linked. They must be separated by blank spaces or plus signs (+). If a plus sign is the last character typed, the prompt will reappear. There is no default; a response is required.
Run File [Object-file.EXE]:	Give filename for executable object code. The default is first-object-filename.EXE. (You cannot change the output extension.)
List File [Run-file.MAP]:	Give filename for listing. The default is RUN filename.
Libraries []:	List filenames to be searched, separated by blank spaces or plus signs (+). If a plus sign is the last character typed, the prompt will reappear. The default is to search for default libraries in the object modules. (Extensions will be changed to (LIB.)

9.5.2 Method 2: Command Line

To start MS-LINK using Method 2, type all commands on one line. The entries following LINK are responses to the command prompts. The entry fields for the different prompts must be separated by commas. Use the following syntax:

```
LINK <object-list>,<runfile>,<listfile>,<lib-list>[/switch...]
```

The entries following LINK are responses to the command prompts. The entry fields for the different prompts must be separated by commas.

where: object-list is a list of object modules, separated by plus signs.

runfile is the name of the file to receive the executable output.

listfile is the name of the file to receive the listing.

lib-list is a list of library modules to be searched.

/switch refers to optional switches, which may be placed following any of the response entries (just before any of the commas or after the <lib-list>, as shown).

To select the default for a field, simply type a second comma with no spaces between the two commas.

Example:

```
LINK FUN+TEXT+TABLE+CARE/P/M,,FUNLIST,COBLIB.LIB
```

This command causes MS-LINK to be loaded, then the object modules FUN.OBJ, TEXT.OBJ, TABLE.OBJ, and CARE.OBJ are loaded. MS-LINK then pauses (as a result of using the -P switch). MS-LINK links the object modules when you press any key, and produces a global symbol map (the -M switch); defaults to FUN.EXE Run file; creates a List file named FUNLIST.MAP; and searches the Library file COBLIB.LIB.

9.5.3 Method 3: Response File

To start MS-LINK with Method 3, type:

```
LINK @<filespec>
```

where: filespec is the name of a response file. A response file contains answers to the MS-LINK prompts (shown in Method 1) and may also contain any of the switches. When naming a response file, the use of filename extensions is optional. Method 3 permits the command that starts MS-LINK to be entered from the keyboard or within a batch file without requiring you to take any further action.

To use this option, you must create a response file containing several lines of text, each of which is the response to an MS-LINK prompt. The responses must be in the same order as the MS-LINK prompts discussed in Method 1. If desired, a long response to the "Object Modules:" or "Libraries:" prompt may be typed on several lines by using a plus sign (+) to continue the same response onto the next line.

Use switches and command characters in the response file the same way as they are used for responses typed on the terminal keyboard.

When the MS-LINK session begins, each prompt will be displayed in order with the responses from the response file. If the response file does not contain answers for all the prompts, (in the form of filenames, the semicolon command character or carriage returns), MS-LINK will display the prompt which does not have a response, then wait for you to type a legal response. When a legal response has been typed, MS-LINK continues the link session.

Example:

```
FUN TEXT TABLE CARE
/PAUSE/MAP
FUNLIST
COBLIB.LIB
```

This response file tells MS-LINK to load the four object modules named FUN, TEXT, TABLE, and CARE. MS-LINK pauses before producing a public symbol map to permit you to swap disks (see discussion under /PAUSE in the Switches section before using this feature). When you press any key, the output files will be named FUN.EXE and FUNLIST.MAP. MS-LINK will search the library file COBLIB.LIB, and will use the default settings for the switches.

9.6 COMMAND CHARACTERS

MS-LINK provides three command characters.

Plus sign Use the plus sign (+) to separate entries and to extend the current line in response to the "Object Modules:" and "Libraries:" prompts. (A blank space may be used to separate object modules.) To type a large number of responses (each may be very long), type a plus sign/<RETURN> at the end of the line to extend it. If the plus sign/<RETURN> is the last entry following these two prompts, MS-LINK will prompt you for more module names. When the "Object Modules:" or "Libraries:" prompt appears again, continue to type responses. When all the modules to be linked and libraries to be searched have been listed, be sure the response line ends with a module name and a <RETURN> and not a plus sign/<RETURN>.

Example:

```
Object Modules [.OBJ]: FUN TEXT
TABLE CARE+<RETURN>
Object Modules [.OBJ]:
FOO+FLIPFLOP+JUNQUE+<RETURN>
Object Modules [.OBJ]:
CORSAIR<RETURN>
```

Semicolon To select default responses to the remaining prompts, use a single semicolon (:) followed immediately by a carriage return at any time after the first prompt (Run File:). This feature saves time and overrides the need to press a series of <RETURN> keys.

NOTE

Once the semicolon has been typed and entered (by pressing the <RETURN> key), you can no longer respond to any of the prompts for that link session. Therefore, do not use the semicolon to skip some prompts. To skip prompts, use the <RETURN> key.

Example:

```
Object Modules
[.OBJ]: FUN TEXT TABLE CARE<RETURN>
Run Module [FUN.EXE]: ;<RETURN>
```

No other prompts will appear, and MS-LINK will use the default values (including FUN.MAP for the List file).

<CONTROL-C> Use the <CONTROL-C> key to abort the link session at any time. If you type an erroneous response, such as the wrong filename or an incorrectly spelled filename, you must press <CONTROL-C> to exit MS-LINK then restart MS-LINK. If the error has been typed but you have not pressed the <RETURN> key, you may delete the erroneous characters with the backspace key, but for that line only.

9.7 COMMAND PROMPTS

MS-LINK asks you for responses to four text prompts. When you have typed a response to a prompt and pressed <RETURN>, the next prompt appears. When the last prompt has been answered, MS-LINK begins linking automatically without further command. When the link session is finished, MS-LINK exits to the operating system. When the operating system prompt appears, MS-LINK has finished successfully. If the link session is unsuccessful, MS-LINK will display the appropriate error message.

MS-LINK prompts the user for the names of Object, Run, and List files, and for Libraries. The prompts are listed in order of appearance. The default response is shown in square brackets ([]) following the prompt, for prompts which can default to preset responses. The "Object Modules:" prompt has no preset filename response and requires you to type a filename.

Object Modules [.OBJ]:

Type a list of the object modules to be linked. MS-LINK assumes by default that the filename extension is .OBJ. If an object module has any other filename extension, the extension must be given. Otherwise, the extension may be omitted.

Modules must be separated by plus signs (+).

Remember that MS-LINK loads segments into classes in the order encountered. You can use this information to set the order in which the object modules will be read by MS-LINK. Refer to the Macro Assembler Manual for more information on this process.

Run File [First-Object-filename.EXE]:

Typing a filename will create a file for storing the Run (executable) file that results from the link session. All Run files receive the filename extension .EXE, even if you specify an extension other than .EXE.

If no response is typed to the "Run File:" prompt, MS-LINK uses the first filename typed in response to the "Object Modules:" prompt as the RUN filename.

Example:

Run File [FUN.EXE]: B:PAYROLL/P

This response directs MS-LINK to create the Run file PAYROLL.EXE on drive B:. Also, MS-LINK will pause, which allows you to insert a new disk to receive the Run file.

List File [Run-Filename.MAP]:

The List file contains an entry for each segment in the input (object) modules. Each entry also shows the addressing in the Run file.

The default response is the Run filename with the default filename extension .MAP.

Libraries []:

The valid responses are up to eight library filenames or simply a carriage return. (A carriage return means default library search.) Library files must have been created by a library utility. (Consult the MS-LIB section of the Macro Assembler Manual for information on library files.) MS-LINK assumes by default that the filename extension is .LIB for library files.

Library filenames must be separated by blank spaces or plus signs (+).

MS-LINK searches library files in the order listed to resolve external references. When it finds the module that defines the external symbol, MS-LINK processes that module as another object module.

If MS-LINK cannot find a library file on the disks in the disk drives, it will display the message:

Cannot find library <library-name>
Type new drive letter:

Press the letter for the drive designation
(for example, B).

9.8 MS-LINK SWITCHES

The seven MS-LINK switches control various MS-LINK functions. Switches must be typed at the end of a prompt response, regardless of which method is used to start MS-LINK. Switches may be grouped at the end of any response, or may be scattered at the end of several. If more than one switch is typed at the end of one response, each switch must be preceded by a slash (/).

All switches may be abbreviated. The only restriction is that an abbreviation must be sequential from the first letter through the last typed; no gaps or transpositions are allowed. For example:

<u>Legal</u>	<u>Illegal</u>
/D	/DSL
/DS	/DAL
/DSA	/DLC
/DSALLOCA	/DSALLOCT

/DSALLOCATE

Using the /DSALLOCATE switch tells MS-LINK to load all data at the high end of the Data Segment. Otherwise, MS-LINK loads all data at the low end of the Data Segment. At runtime, the DS pointer is set to the lowest possible address to allow the entire DS segment to be used. Use of the /DSALLOCATE switch in combination with the default load low (that is, the /HIGH switch is not used) permits the user application to dynamically allocate any available memory below the area specifically allocated within DGroup, yet to remain addressable by the same DS pointer. This dynamic allocation is needed for Pascal and FORTRAN programs.

NOTE

Your application program may dynamically allocate up to 64K bytes (or the actual amount of memory available) less the amount allocated within DGroup.

/HIGH

Use of the /HIGH switch causes MS-LINK to place the Run file as high as possible in memory. Otherwise, MS-LINK places the Run file as low as possible.

IMPORTANT

Do not use the /HIGH switch with Pascal or FORTRAN programs.

/LINENUMBERS

The /LINENUMBERS switch tells MS-LINK to include in the List file the line numbers and addresses of the source statements in the input modules. Otherwise, line numbers are not included in the List file.

NOTE

Not all compilers produce object modules that contain line number information. In these cases, of course, MS-LINK cannot include line numbers.

/MAP

/MAP directs MS-LINK to list all public (global) symbols defined in the input modules. If /MAP is not given, MS-LINK will list only errors (including undefined globals).

The symbols are listed alphabetically. For each symbol, MS-LINK lists its value and its segment:offset location in the Run file. The symbols are listed at the end of the List file.

/PAUSE

The /PAUSE switch causes MS-LINK to pause in the link session when the switch is encountered. Normally, MS-LINK performs the linking session from beginning to end without stopping. This switch allows the user to swap the disks before MS-LINK outputs the Run (.EXE) file.

When MS-LINK encounters the /PAUSE switch, it displays the message:

```
About to generate .EXE file  
Change disks <hit any key>
```

MS-LINK resumes processing when the user presses any key.

CAUTION

Do not remove the disk which will receive the List file, or the disk used for the VM.TMP file, if one has been created.

/STACK:<number>

number represents any positive numeric value (in hexadecimal radix) up to 65536 bytes. If a value from 1 to 511 is typed, MS-LINK will use 512. If the /STACK switch is not used for a link session, MS-LINK will calculate the necessary stack size automatically.

All compilers and assemblers should provide information in the object modules that allow the linker to compute the required stack size.

At least one object (input) module must contain a stack allocation statement. If not, MS-LINK will display the following error message:

WARNING: NO STACK STATEMENT

/NO

/NO is short for NODEFAULTLIBRARYSEARCH. This switch tells MS-LINK to not search the default (product) libraries in the object modules. For example, if you are linking object modules in Pascal, specifying the /NO switch tells MS-LINK to not automatically search the library named PASCAL.LIB to resolve external references.

9.9 SAMPLE MS-LINK SESSION

This sample shows you the type of information that is displayed during an MS-LINK session.

In response to the MS-DOS prompt, type:

LINK

The system displays the following messages and prompts (your answers are underlined):

Microsoft Object Linker V.2.00
(C) Copyright 1982 by Microsoft Inc.

Object Modules [.OBJ]: IO SYSINIT
Run File [IO.EXE]:
List File [NUL.MAP]: IO /MAP
Libraries [.LIB]: i

Notes:

1. By specifying /MAP, you get both an alphabetic listing and a chronological listing of public symbols.
2. By responding PRN to the "List File:" prompt, you can redirect your output to the printer.
3. By specifying the /LINE switch, MS-LINK gives you a listing of all line numbers for all modules. (Note that the /LINE switch can generate a large volume of output.)
4. By pressing <RETURN> in response to the "Libraries:" prompt, an automatic library search is performed.

Once MS-LINK locates all libraries, the linker map displays a list of segments in the order of their appearance within the load module. The list might look like this:

Start	Stop	Length	Name
00000H	009ECH	09EDH	CODE
009F0H	01166H	0777H	SYSINITSEG

The information in the Start and Stop columns shows the 20-bit hex address of each segment relative to location zero. Location zero is the beginning of the load module.

The addresses displayed are not the absolute addresses where these segments are loaded. Consult the Macro Assembler Manual for information on how to determine where relative zero is actually located, and also on how to determine the absolute address of a segment.

Because the /MAP switch was used, MS-LINK displays the public symbols by name and value. For example:

ADDRESS	PUBLICS_BY_NAME
009F:0012	BUFFERS
009F:0005	CURRENT_DOS_LOCATION
009F:0011	DEFAULT_DRIVE
009F:000B	DEVICE_LIST
009F:0013	FILES
009F:0009	FINAL_DOS_LOCATION
009F:000F	MEMORY_SIZE
009F:0000	SYSINIT

ADDRESS	PUBLICS_BY_VALUE
009F:0000	SYSINIT
009F:0005	CURRENT_DOS_LOCATION
009F:0009	FINAL_DOS_LOCATION
009F:000B	DEVICE_LIST
009F:000F	MEMORY_SIZE
009F:0011	DEFAULT_DRIVE
009F:0012	BUFFERS
009F:0013	FILES

For more information on MS-LINK, refer to the Macro Assembler Manual.

9.10 ERROR MESSAGES

All errors cause the link session to abort. After the cause has been found and corrected, MS-LINK must be rerun. The following error messages are displayed by MS-LINK:

ATTEMPT TO ACCESS DATA OUTSIDE OF SEGMENT BOUNDS, POSSIBLY
BAD OBJECT MODULE

There is probably a bad Object file.

BAD NUMERIC PARAMETER

Numeric value is not in digits.

CANNOT OPEN TEMPORARY FILE

MS-LINK is unable to create the file VM.TMP because the disk directory is full. Insert a new disk. Do not remove the disk that will receive the List.MAP file.

ERROR: DUP RECORD TOO COMPLEX

DUP record in assembly language module is too complex. Simplify DUP record in assembly language program.

ERROR: FIXUP OFFSET EXCEEDS FIELD WIDTH

An assembly language instruction refers to an address with a short instruction instead of a long instruction. Edit assembly language source and reassemble.

INPUT FILE READ ERROR

There is probably a bad Object file.

INVALID OBJECT MODULE

An object module(s) is incorrectly formed or incomplete (as when assembly is stopped in the middle).

SYMBOL DEFINED MORE THAN ONCE

MS-LINK found two or more modules that define a single symbol name.

PROGRAM SIZE OR NUMBER OF SEGMENTS EXCEEDS CAPACITY OF LINKER

The total size may not exceed 1M bytes and the number of segments may not exceed 255.

REQUESTED STACK SIZE EXCEEDS 64K

Specify a size greater than or equal to 64K bytes with the /STACK switch.

SEGMENT SIZE EXCEEDS 64K

64K bytes is the addressing system limit.

SYMBOL TABLE CAPACITY EXCEEDED

Very many and/or very long names were typed, exceeding the limit of approximately 25K bytes.

TOO MANY EXTERNAL SYMBOLS IN ONE MODULE

The limit is 256 external symbols per module.

TOO MANY GROUPS

The limit is 10 groups.

TOO MANY LIBRARIES SPECIFIED

The limit is 8 libraries.

TOO MANY PUBLIC SYMBOLS

The limit is 1024 public symbols.

TOO MANY SEGMENTS OR CLASSES

The limit is 256 (segments and classes taken together).

UNRESOLVED EXTERNALS: <list>

The external symbols listed have no defining module among the modules or library files specified.

VM READ ERROR

This is a disk error; it is not caused by MS-LINK.

WARNING: NO STACK SEGMENT

None of the object modules specified contains a statement allocating stack space, but the user typed the /STACK switch.

WARNING: SEGMENT OF ABSOLUTE OR UNKNOWN TYPE

There is a bad object module or an attempt has been made to link modules that MS-LINK cannot handle (e.g., an absolute object module).

WRITE ERROR IN TMP FILE

No more disk space remains to expand VM.TMP file.

WRITE ERROR ON RUN FILE

Usually, there is not enough disk space for the Run file.

APPENDIX A

DISK ERRORS

If a disk error occurs at any time during a command or program, MS-DOS retries the operation three times. If the operation cannot be completed successfully, MS-DOS returns an error message in the following format:

```
<yyy> ERROR WHILE <I/O action> ON DRIVE x  
Abort,Ignore,Retry:_
```

In this message,<yyy> may be one of the following:

```
WRITE PROTECT  
NOT READY  
SEEK  
DATA  
SECTOR NOT FOUND  
WRITE FAULT  
DISK
```

The <I/O-action> may be either of the following:

```
READING  
WRITING
```

The drive <x> indicates the drive in which the error has occurred.

MS-DOS waits for you to enter one of the following responses:

- A Abort. Terminate the program requesting the disk read or write.
- I Ignore. Ignore the bad sector and pretend the error did not occur.
- R Retry. Repeat the operation. This response is to be used when the operator has corrected the error (such as with NOT READY or WRITE PROTECT errors).

Usually, you will want to attempt recovery by entering responses in this order:

R (to try again)
A (to terminate program and try a new disk)

One other error message might be related to faulty disk read or write:

FILE ALLOCATION TABLE BAD FOR DRIVE X

This message means that the copy in memory of one of the allocation tables has pointers to nonexistent blocks. Possibly the disk was incorrectly formatted or not formatted before use. If this error persists, the disk is currently unusable and must be formatted prior to use.

APPENDIX B

ANSI ESCAPE SEQUENCES

NOTE

Information in this appendix is installation-dependent and may not be implemented on every manufacturer's machine.

An ANSI escape sequence is a series of characters (beginning with an escape character or keystroke) that you can use to define functions to MS-DOS. Specifically, you can reassign keys, change graphics functions, and affect cursor movement.

This appendix explains how the ANSI escape sequences are defined for MS-DOS version 2.0. Examples on how to use ANSI escape sequences are included at the end of this appendix.

Notes:

1. The default value is used when no explicit value or a value of zero is specified.
2. Pn represents "numeric parameter." This is a decimal number specified with ASCII digits.
3. Ps represents "selective parameter." This is any decimal number that is used to select a subfunction. Multiple subfunctions may be selected by separating the parameters with semicolons.

B.1 CURSOR FUNCTIONS

The following escape sequences affect the cursor position on the screen.

CUP - Cursor Position

ESC [P1 ; P2 H

HVP - Horizontal and Vertical Position

ESC [P1 ; P2 f

CUP and HVP move the cursor to the position specified by the parameters. The first parameter specifies the line number, and the second parameter specifies the column number. The default value is 1. When no parameters are specified, the cursor is moved to the home position.

CUU - Cursor Up

ESC [Pn A

This sequence moves the cursor up one line without changing columns. The value of Pn determines the number of lines moved. The default value for Pn is 1. The CUU sequence is ignored if the cursor is already on the top line.

CUD - Cursor Down

ESC [Pn B

This sequence moves the cursor down one line without changing columns. The value of Pn determines the number of lines moved. The default value for Pn is 1. The CUD sequence is ignored if the cursor is already on the bottom line.

CUF - Cursor Forward

ESC [Pn C

The CUF sequence moves the cursor forward one column without changing lines. The value of Pn determines the number of columns moved. The default value for Pn is 1. The CUF sequence is ignored if the cursor is already in the far right column.

CUB - Cursor Backward

```
ESC [ Pn D
```

This escape sequence moves the cursor back one column without changing lines. The value of Pn determines the number of columns moved. The default value for Pn is 1. The CUB sequence is ignored if the cursor is already in the far left column.

DSR - Device Status Report

```
ESC [ 6 n
```

The console driver will output a CPR sequence (see below) on receipt of the DSR escape sequence.

CPR - Cursor Position Report (from console driver to system)

```
ESC [ Pn ; Pn R
```

The CPR sequence reports current cursor position via standard input. The first parameter specifies the current line and the second parameter specifies the current column.

SCP - Save Cursor Position

```
ESC [ s
```

The current cursor position is saved. This cursor position can be restored with the RCP sequence (see below).

RCP - Restore Cursor Position

```
ESC [ u
```

This sequence restores the cursor position to the value it had when the console driver received the SCP sequence.

B.2 ERASING

The following escape sequences affect erase functions.

ED - Erase Display

ESC [2 J

The ED sequence erases the screen, and the cursor goes to the home position.

EL - Erase Line

ESC [K

This sequence erases from the cursor to the end of the line (including the cursor position).

B.3 MODES OF OPERATION

The following escape sequences affect screen graphics.

SGR - Set Graphics Rendition

ESC [Ps ; ... ; PS m

The SGR escape sequence invokes the graphic functions specified by the parameter(s) described below. The graphic functions remain until the next occurrence of an SGR escape sequence.

Parameter	Parameter Function	
0	All Attributes off	
1	Bold on	
4	Underscore on	(monochrome displays only)
5	Blink on	
7	Reverse Video on	
8	Concealed on	
30	Black foreground	(ISO 6429 standard)
31	Red foreground	(ISO 6429 standard)
32	Green foreground	(ISO 6429 standard)
33	Yellow foreground	(ISO 6429 standard)
34	Blue foreground	(ISO 6429 standard)
35	Magenta foreground	(ISO 6429 standard)
36	Cyan foreground	(ISO 6429 standard)

37	White foreground	(ISO 6429 standard)
40	Black background	(ISO 6429 standard)
41	Red background	(ISO 6429 standard)
42	Green background	(ISO 6429 standard)
43	Yellow background	(ISO 6429 standard)
44	Blue background	(ISO 6429 standard)
45	Magenta background	(ISO 6429 standard)
46	Cyan background	(ISO 6429 standard)
47	White background	(ISO 6429 standard)

SM - Set Mode

ESC [= Ps h
 or ESC [= h
 or ESC [= 0 h
 or ESC [? 7 h

The SM escape sequence changes the screen width or type to one of the following parameters:

Parameter Parameter Function

0	40 x 25 black and white
1	40 x 25 color
2	80 x 25 black and white
3	80 x 25 color
4	320 x 200 color
5	320 x 200 black and white
6	640 x 200 black and white
7	wrap at end of line

RM - Reset Mode

ESC [= Ps 1
 or ESC [= 1
 or ESC [= 0 1
 or ESC [? 7 1

Parameters for RM are the same as for SM (Set Mode), except that parameter 7 will reset the wrap at the end of line mode.

B.4 KEYBOARD REASSIGNMENT

Although not part of the ANSI 3.64-1979 or ISO 6429 standard, the following keyboard reassessments are compatible with these standards.

The control sequence is:

ESC [Pn ; Pn ; ... Pn p
or ESC ["string" ; p
or ESC [Pn ; "string" ; Pn ; Pn ; "string" ; Pn p
or any other combination of strings and decimal numbers

The final code in the control sequence (p) is one reserved for private use by the ANSI 3.64-1979 standard.

The first ASCII code in the control sequence defines which code is being mapped. The remaining numbers define the sequence of ASCII codes generated when this key is intercepted. Note that there is one exception: if the first code in the sequence is zero (NUL), then the first and second code make up an extended ASCII redefinition.

Examples:

1. Reassign the Q and q key to the A and a key (and vice versa):

ESC [6 5 ; 8 1 p	A becomes Q
ESC [9 7 ; 1 1 3 p	a becomes q
ESC [8 1 ; 6 5 p	Q becomes A
ESC [1 1 3 ; 9 7 p	q becomes a

2. Reassign the F10 key to a DIR command followed by a carriage return:

ESC [0 ; 6 8 ; " d i r " ; 1 3 p

The 0;68 is the extended ASCII code for the F10 key; 13 decimal is a carriage return.

APPENDIX C

HOW TO CONFIGURE YOUR SYSTEM

In many cases, there are installation-specific settings for MS-DOS that need to be configured at system startup. An example of this is a standard device driver, such as an online printer.

The MS-DOS configuration file (CONFIG.SYS) allows you to configure your system with a minimum of effort. With this file, you can add device drivers to your system at startup. The configuration file is simply an ASCII file that has certain commands for MS-DOS startup (boot). The boot process is as follows:

1. The disk boot sector is read. This contains enough code to read MS-DOS code and the installation's BIOS (machine-dependent code).
2. The MS-DOS code and BIOS are read.
3. A variety of BIOS initializations are done.
4. A system initialization routine reads the configuration file (CONFIG.SYS), if it exists, to perform device installation and other user options. Its final task is to execute the command interpreter, which finishes the MS-DOS boot process.

C.1 CHANGING THE CONFIG.SYS FILE

If there is not a CONFIG.SYS file on the MS-DOS disk, you can use the MS-DOS editor, EDLIN, to create a file; then save it on the MS-DOS disk on your root directory.

The following is a list of commands for the configuration file CONFIG.SYS:

BUFFERS = <number>

This is the number of sector buffers that will comprise the system list. It is installation-dependent. If not set, 10 is a reasonable number.

FILES = <number>

This is the number of open files that the XENIX system calls can access. It is installation-dependent. If not set, 10 is a reasonable number.

DEVICE = <filename>

This installs the device driver in <filename> into the system list. (See below.)

BREAK = <ON or OFF>

If ON is specified (the default is OFF), a check for CONTROL-C as input will be made every time the system is called. ON improves the ability to abort programs over previous versions of MS-DOS.

SHELL = <filename>

This begins execution of the shell (top-level command processor) from <filename>.

A typical configuration file might look like this:

```
Buffers = 10
Files   = 10
Device  = \BIN\NETWORK.SYS
Break   = ON
Shell   = A:\BIN\COMMAND.COM A:\BIN /P
```

Note here that the Buffers and Files parameters are set to 10. The system initialization routine will search for the filename \BIN\NETWORK.SYS to find the device that is being added to the system. This file is usually supplied on disk with your device. Make sure that you save the device file in the pathname that you specify in the Device parameters.

This configuration file also sets the MS-DOS command EXEC to the COMMAND.COM file located on disk A: in the \BIN directory. The A:\BIN tells COMMAND.COM where to look for itself when it needs to re-read from disk. The /P tells COMMAND.COM that it is the first program running on the system so that it can process the MS-DOS EXIT command.

APPENDIX D

SEATTLE COMPUTER PRODUCTS I/O SYSTEM

The I/O system consists of several individual modules that are linked together to form one common binary file called IO.SYS. This file is resident on the disk, but it is hidden from the user during normal directory operations. In fact, it is the first file that is installed on the disk when formatted. The boot program loads this file and the next sequentially placed file MSDOS.SYS. These files are placed in the first sequential data sectors on the disk; that is why they are always located first in the directory.

For detailed explanations of MS-DOS 2.0, consult the MS-DOS User's Guide and the MS-DOS Programmer's Reference Manual. The Programmer's Reference Manual contains information about how devices are interfaced to the system. The I/O system for SCP is structured just like the examples for device drivers given in the manual.

MODIFYING I/O SYSTEM MODULES

Because the I/O system is separated into individual modules, you can easily modify individual devices if you are familiar with the structure. The old IO.SYS for MS-DOS 1.25 was assembled to binary code using SCP's ASM.COM assembler. The new system is assembled under MASM format so that the linker can be used.

There is still a simple equate definition file (IODEF.ASM) for simple modifications. This file is located in the root directory. All source files are located in the source directory; object files for linking are in the object directory. A simple batch file MAKIOSYS.BAT will reassemble all the source files and link them together. However, to make simple modifications it is not necessary to reassemble everything. Which modules need to be re-assembled depends on what you are modifying. The following is a list of the modules and what each one contains.

I/O SYSTEM MODULES**IO.ASM**

This is the main source file that contains the device headers for all block (disk) and I/O devices. If any changes are to be made to disk (either hard or floppy) this file should also be re-assembled.

This file also contains some initialization code to jump to system initialization and other information that DOS needs. The header table itself contains the standard I/O devices. Console (CON), printer (PRN), the clock (CLOCK) and auxiliary (AUX) devices are defined here.

To create new devices that link in with the others, add them to the list. However, the best way to add new devices is to make them installable at boot time.

The block device structure is important. The drive assignments are calculated from the order of the block assignments. If floppy disks were listed before hard disks, they would be given the lowest assignments (for example, A:,B:,etc.) A binary number located at the end position of each header for the block device tells the DOS how many assignments for this device. The equate put here comes from IODEF.ASM. If you alter the order of these devices, you must make sure that each header has the proper information. The same position in that header for I/O devices gives the name assigned to the device (for example, "CLOCK","PRN",etc.). See the MS-DOS Programmer's Reference Manual for further description.

- CONIO.ASM The standard console device driver. It contains all the necessary code to drive the console device.
- For input from the console, there is a buffer that can be interrupt driven. It is selectable in IODEF.ASM.
- For output there is built in converter from ANSI cursor control sequences to any desired terminal. Microsoft has recommended that to simplify things, you should modify the driver so application programs could all use ANSI cursor sequences, with conversion done in the I/O system rather than the applications program. This makes programs such as word processing more portable. The CLS function in the DOS outputs a standard ANSI 'ED' code to clear the screen. A simple table has been set up so you can easily modify this code for a specific terminal. An example is given for the HEATH/ZENITH terminal configuration.
- AUXIO. ASM The driver for the auxiliary (AUX) port. Equates set up in the IODEF.ASM determine whether this is set to the second port of the SCP Multiport serial card or to the parallel port on the CPU support card.
- PRNIO.ASM The driver for the standard (PRN) printer device. IODEF.ASM equates determine where the physical I/O address of this device is located.
- TIME.ASM The driver for the standard (CLOCK) clock device. This is fixed to run the 9513 clock source on the CPU Support card. Any other device you desire to be as clock must have this code modified.
- FDISK.ASM The floppy disk driver routines for the I/O system. Several equates are set up in the IODEF file for disk parameters. All floppy disk drivers are contained in this one module, since there is only one floppy disk controller in a normal system.
- If you use more than one floppy disk controller, it is advised that you create a separate module to support it and link that module with the I/O system in the header file (IO.ASM), or create a separate installable device driver.

HDISK.ASM

The hard disk driver routines for the I/O system. Like the floppy disk routines, equates in IODEF.ASM control various parameters. Note that this routine can be completely separated from the I/O system and become an installable device driver as set by equate.

If you desire that, set the equate to install, assemble the file by itself, link it by itself, and convert it (EXE2BIN) to a binary file. Do not link the HDISK.OBJ file with the rest of the I/O system. You can specify the system to load this file in at boot time by putting the following in the CONFIG.SYS file (which is a standard ASCII file).

DEVICE = HDISK.BIN

This is the same method used to set up all installable device drivers.

SYSINIT.OBJ

This is the system initialization module provided by Microsoft. It loads in the command interpreter and reads the CONFIG.SYS file to set up parameters for the system. It also loads in any installable device drivers if specified in the CONFIG.SYS file.

SYSIMES.OBJ

This module holds the console messages for the SYSINIT.OBJ module if needed.

Note that in many of the source files, the code is broken up into various segments. These segments are all grouped together under one class defined as IOSYS so that they are loaded as one complete segment. Many modules require initialization while the system is being loaded, (for example, setting up interrupt vectors, initializing baud rates, etc.). The initialization code for all the modules required is grouped together as one segment called INITSEG.

After the I/O system file is loaded, it will first execute any code that is in this segment. Another segment called LASTSEG is executed last by the I/O system. It will setup some system parameters. Most of the code for this segment is also located in the IO.ASM file. If you wish to create new devices to be linked in with the I/O system and they require initialization you should set up your segment declarations exactly as used by the provided modules for proper operation.

Comment Form

Cut along line

Use this form to comment on this product and to report software problems or errors in the manual. (If you are reporting a software problem, attach a listing if possible.)

Software Description:

Software Product _____ Version No. _____

Operating System _____ Version No. _____

Other Software Information _____

Hardware Description:

Seattle Computer Model No. _____ Memory Size _____ KB

Media: Size _____" Format: Sides _____ Density _____

Other System Hardware _____

Comments:

Name _____ Company _____

Street _____

City _____ State _____ Zip _____

Phone _____ Date _____

Cut along line

Fold and tape

Place
stamp
here

Seattle Computer Products
1114 Industry Drive
Seattle, WA 98188

Attn: Software Support

Fold and tape



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Microsoft® CREF

Cross-Reference Utility

for 8086 and 8088 Microprocessors

CREF
Utility



1114 Industry Dr. Seattle WA 98188 206/575-1830

Microsoft® CREF

Cross-Reference Utility
for 8086 and 8088 Microprocessors



System Requirements

The Microsoft CREF Cross-Reference Utility requires:

24K bytes of memory minimum:

 14K bytes for code

 10K bytes for run space

Disk drive(s):

 1 disk drive if and only if output is sent to the same physical disk from which the input was taken.

The Microsoft CREF Cross-Reference Utility does not allow time to swap disks during operation on a one-drive configuration. Therefore, two disk drives is a more practical configuration.



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CHAPTER 1

INTRODUCTION

1.1 FEATURES OF MS-CREF

The Microsoft CREF Cross-Reference Utility can help you in debugging your assembly language programs. MS-CREF outputs an alphabetical listing of all the symbols to a special file created by your assembler. With this listing, you can quickly locate all occurrences of any symbol in your source program by line number.

The cross-reference listing produced by MS-CREF gives you symbol locations, speeding your search and allowing faster debugging.

The MS-CREF listing is used with the symbol table produced by your assembler.

The symbol table listing shows the value, type, and length of each symbol. This information is needed to correct erroneous symbol definitions or uses.

1.2 OVERVIEW OF MS-CREF OPERATION

MS-CREF produces a file with cross-references for symbolic names in your program.

First, you must create a cross-reference file with the assembler. Then, MS-CREF converts this cross-reference file (which has the filename extension .CRF) into an alphabetical listing of the symbols in the file. The cross-reference listing file is given the default filename extension .REF.

Beside each symbol in the listing, MS-CREF lists the line numbers where the symbol occurs in the source program. The line numbers are listed in ascending sequence. The line number where the symbol is defined is indicated by a pound sign (#).

Figure 1 illustrates the MS-CREF operation.

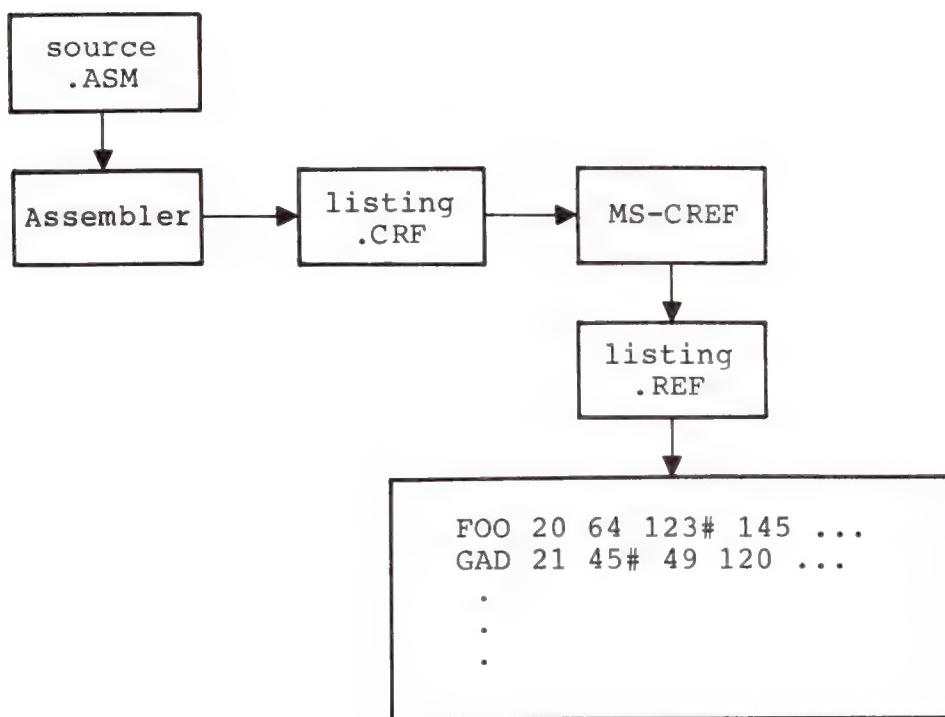


Figure 1. MS-CREF Operation



CHAPTER 2

RUNNING MS-CREF

Running MS-CREF requires two types of commands: a command to start MS-CREF and answers to command prompts. You type all the commands to MS-CREF on a command line or in response to MS-CREF prompts. Command characters can be used to assist you while giving commands to MS-CREF.

Before you can use MS-CREF to create the cross-reference listing, you must first create a cross-reference file using your assembler. This step is described in the next section.

2.1 HOW TO CREATE A CROSS-REFERENCE FILE

A cross-reference file is created during an assembly session. To create a cross-reference file, use the Microsoft Macro Assembler and answer the fourth command prompt with the name of the cross-reference file you want to create.

The fourth assembler prompt is:

Cross-reference]NUL.CRF[:

If you do not type a filename in response to this prompt, or if you use the default response, the assembler will not create a cross-reference file. Therefore, you must type a filename if you want to create a cross-reference file.

You may also specify which drive or device you want the file saved on, and the filename extension (if different from you must specify the filename extension when naming the file in response to the first MS-CREF prompt. (Refer to Section 2.2, "How to Start MS-CREF," for a description of MS-CREF prompts.)

You are now ready to use MS-CREF to convert the cross-reference file produced by the assembler into a cross-reference listing.

2.2 HOW TO START MS-CREF

MS-CREF may be started two ways. By the first method, you type the commands as answers to individual prompts. By the second method, you type all commands on the line used to start MS-CREF.

Summary of Methods to Start MS-CREF

Method 1 CREF

Method 2 CREF <crffile>,<listing>

2.2.1 Method 1: Prompts

To start MS-CREF using prompts, type:

CREF

MS-CREF will be loaded into memory. Then, MS-CREF displays two text prompts that appear one at a time. You answer the prompts to command MS-CREF to convert a cross-reference file into a cross-reference listing.

Command Prompts

Cross reference] .CRF[:

Type the name of the cross-reference file you want MS-CREF to convert to a cross-reference listing. The filename is the name you specified when you directed the assembler to produce the cross-reference file.

MS-CREF assumes that the filename extension is .CRF. If you do not specify a filename extension when you type the cross-reference filename, MS-CREF will look for a file with the name you specify and the filename extension .CRF. If your cross-reference file has a different extension, specify that extension when typing the filename.

Refer to Chapter 4, "Format of MS-CREF Compatible Files," for a description of what MS-CREF expects to see in the cross-reference file. You will need this information only if your cross-reference file was not produced by a Microsoft assembler.

Listing]crffile.REF[:

Type the name you want the cross-reference listing file to have. MS-CREF will automatically give the cross-reference listing the filename extension .REF.

If you want your cross-reference listing to have the same filename as the cross-reference file but with the filename extension .REF, simply press the <RETURN> key when the Listing: prompt appears. If you want your cross-reference listing file to be named anything else, or to have any other filename extension, you must type a response following the Listing: prompt.

If you want the listing file placed on a drive or device other than the default drive, specify that drive or device when typing your response to the Listing: prompt.

2.2.2 Method 2: Command Line

To start MS-CREF using the command line, type:

```
CREF <crffile>,<listing>
```

MS-CREF will be loaded into memory. Then, MS-CREF converts your cross-reference file into a cross-reference listing.

The entries following CREF are responses to the command prompts. The <crffile> and <listing> fields must be separated by a comma.

where: <crffile> is the name of the cross-reference file produced by your assembler. MS-CREF assumes that the filename extension is .CRF. You may override this default by specifying a different extension. If the file named for the <crffile> does not exist, MS-CREF will display the message:

```
Fatal I/O Error 110
```

```
in File: <crffile>.CRF
```

MS-CREF will be aborted and the operating system prompt will appear.

<listing> is the name of the file you want to contain the cross-reference listing of symbols in your program.

To select the default filename and extension for the listing file, type a semicolon after the <crffile> name. Refer to the "Command Characters" section for more information on how to use the semicolon.

Examples:

```
CREF FUN;
```

This example causes MS-CREF to process the cross-reference file FUN.CRF and to produce a listing file named FUN.REF.

To give the listing file a different filename, extension, or destination, simply specify it when you type the command line.

CREF FUN,B:WORK.ARG

This example causes MS-CREF to process the cross-reference file named RUN.CRF and to produce a listing file named WORK.ARG, which will be placed on the disk in drive B:.

2.3 COMMAND CHARACTERS

MS-CREF provides two command characters.

Semicolon Use a single semicolon (;), followed immediately by a carriage return, at any time after responding to the Cross reference: prompt to select the default response to the Listing: prompt. This feature saves time and overrides the need to answer the Listing: prompt.

If you use the semicolon, MS-CREF gives the listing file the filename of the cross-reference file and the default filename extension .REF.

Example:

```
Cross reference ].CRF[: FUN;
```

MS-CREF will process the cross-reference file named FUN.CRF and output a listing file named FUN.REF.

CONTROL-C Use <CONTROL-C> at any time to abort the MS-CREF session. If you make a mistake (for example, typing the wrong filename or incorrectly spelling a filename), you must press <CONTROL-C> to exit MS-CREF, and then restart MS-CREF. If the error has been typed but you have not pressed the <RETURN> key, you may delete the erroneous characters, but for that line only.

2.4 FORMAT OF CROSS-REFERENCE LISTINGS

The cross-reference listing is an alphabetical list of all the symbols in your program. Each page begins with the title of the program or program module. Then the symbols are listed. Following each symbol name is a list of the line numbers where the symbol occurs in your program. The line number for the definition has a pound sign (#) appended to it.

An example of a cross-reference listing appears in the next section.

2.4.1 Example Of Cross-Reference Listing

MS-CREF (vers no.) (date)

ENTX PASCAL entry for initializing programs<--comes from
TITLE directive

Symbol	Cross-Reference	(£ is definition)	Cref-1
AAAXQQ	37£ 38		
BEGHQQ	83 84£ 154 176		
BEGOQQ	33 162		
BEGXQQ	113 126£ 164 223		
CESXQQ	97 99£ 129		
CLNEQQ	67 68£		
CODE	37 182		
CONST. . . .	104 104 105 110		
CRCXQQ	93 94£ 210 215		
CRDXQQ	95 96£ 216		
CSXEQQ	65 66£ 149		
CURHQQ	85 86£ 155		
DATA	64£ 64 100 110		
DGROUP	110£ 111 111 127	111	153 171 172
DOSOFF	98£ 198 199		
DOSXQQ	184 204£ 219		
ENDHQQ	87 88£ 158		
ENDOQQ	33£ 195		
ENDUQQ	31£ 197		
ENDXQQ	184 194£		
ENDYQQ	32£ 196		
ENTGQQ	30£ 187		
ENTXCM	182£ 183 221		
FREXQQ	169 170£ 178		
HDRFQQ	71 72£ 151		
HDRVQQ	73 74£ 152		
HEAP	42 44 110		
HEAPBEG. . . .	54£ 153 172		
HEAPLOW. . . .	43 171		
INIUQQ	31 161		
MAIN STARTUP	109£ 111 180		
MEMORY	42 48£ 48 49 109 110		
PNUXQQ	69 70 150		
RECEQQ	81 82£		

REFEQQ 77 78£
REPEQQ 79 80£
RESEQQ 75 76£ 148
ENTX PASCAL entry for initializing programs

Symbol Cross-Reference (£ is definition) Cref-2

SKTOP. 59£
SMLSTK 135 137£
STACK. 53£ 53 60 110
STARTMAIN. . . 163 186£ 200
STKBQQ 89 90£ 146
STKHQQ 91 92£ 160

CHAPTER 3

ERROR MESSAGES

All errors cause MS-CREF to abort. Control is returned to the operating system.

All error messages are displayed in the following format:

Fatal I/O Error <error number>
in File: <filename>

where: <filename> is the name of the file where the error occurs.

<error number> is one of the numbers in the following list of errors:

Number	Error
101	Hard data error Unrecoverable disk I/O error
101	Device name error Illegal device specification (for example, X:FOO.CRF)
103	Internal error Report to Microsoft Corporation
104	Internal error Report to Microsoft Corporation
105	Device offline Disk drive door open, no printer attached, or similar device is offline.
106	Internal error Report to Microsoft Corporation
108	Disk full
110	File not found
111	Disk is write protected
112	Internal error Report to Microsoft Corporation
113	Internal error Report to Microsoft Corporation
114	Internal error Report to Microsoft Corporation
115	Internal error Report to Microsoft Corporation

CHAPTER 4

FORMAT OF MS-CREF COMPATIBLE FILES

MS-CREF will process files other than those generated by Microsoft's assembler, as long as the file conforms to the valid MS-CREF format.

4.1 MS-CREF FILE PROCESSING

MS-CREF reads a stream of bytes from the cross-reference file (or source file), sorts them, then emits them as a printable listing file (the .REF file). The symbols are held in memory as a sorted tree. References to the symbols are held in a linked list.

MS-CREF keeps track of line numbers in the source file by the number of end-of-line characters it encounters. Therefore, every line in the source file must contain at least one end-of-line character (see chart below).

MS-CREF places a heading at the top of every page of the listing. The name MS-CREF uses is passed by your assembler from a TITLE (or similar) directive in your source program. The title must be followed by a title symbol (see chart below). If MS-CREF encounters more than one title symbol in the source file, it will use the last title read for all page headings. If MS-CREF does not encounter a title symbol in the file, the title line on the listing will be blank.

4.2 FORMAT OF SOURCE FILES

MS-CREF uses the first three bytes of the source file as format specification data. The rest of the file is processed as a series of records that either begin or end with a byte that identifies the type of record.

4.2.1 First Three Bytes

The PAGE directive in your assembler, which takes arguments for page length and line length, will pass the following information to the cross-reference file:

First Byte

The number of lines to be printed per page (page length range is from 1 to 255 lines).

Second Byte

The number of characters per line (line length range is from 1 to 132 characters).

Third Byte

The Page Symbol (07) that tells MS-CREF that the two preceding bytes define listing page size.

If MS-CREF does not see these first three bytes in the file, it uses default values for page size (page length is 58 lines; line length is 80 characters).

4.2.2 Control Symbols

The two tables below show the types of records that MS-CREF recognizes and the byte values and placement it uses to recognize record types.

Records have a control symbol (which identifies the record type) either as the first byte of the record or as the last byte.

Records That Begin with a Control Symbol

Byte	Value*	Control Symbol	Subsequent Bytes
<hr/>			
01		Reference symbol	Record is a reference to a symbol name (1 to 80 characters)
02		Define symbol	Record is a definition of a symbol name (1 to 80 characters)
04		End-of-line	(none)
05		End-of-file	1AH
<hr/>			

Records That End with a Control Symbol

Byte	Value*	Control Symbol	Preceding Bytes
<hr/>			
06		Title defined	Record is title text (1 to 80 characters)
07		Page length/ line length	One byte for page length followed by one byte for line length
<hr/>			

*For all record types, the byte value represents a control character, as follows:

- 01 Control-A
- 02 Control-B
- 04 Control-D
- 05 Control-E
- 06 Control-F
- 07 Control-G

The Control Symbols are defined as follows:

Reference symbol

Record contains the name of a symbol that is referenced. The name may be from 1 to 80 ASCII characters long. Additional characters are truncated.

Define symbol

Record contains the name of a symbol that is defined. The name may be from 1 to 80 ASCII characters long. Additional characters are truncated.

End-of-line

Record is an end-of-line symbol character only (04H or Control-D).

End-of-file

Record is the end-of-file character (1AH).

Title defined

ASCII characters of the title are to be printed at the top of each listing page. The title may be from 1 to 80 characters long. Additional characters are truncated. The last title definition record encountered is used for the title placed at the top of all pages of the listing. If a title definition record is not encountered, the title line on the listing will be left blank.

Page length/line length

The first byte of the record contains the number of lines to be printed per page (range is from 1 to 255 lines). The second byte contains the number of characters to be printed per page (range is from 1 to 132 characters). The default page length is 58 lines. The default line length is 80 characters.

The following table illustrates CRF file record contents by byte and length of record.

Summary of CRF File Record Contents

Byte Contents	Length of Record
<u>01 symbol_name</u>	2-81 bytes
<u>02 symbol_name</u>	2-81 bytes
<u>04</u>	1 byte
<u>05 1A</u>	2 bytes
<u>title_text 06</u>	2-81 bytes
<u>PL LL 07</u>	3 bytes



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Microsoft® DEBUG

Utility

for 8086 and 8088 Microprocessors

DEBUG
Utility



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Microsoft® DEBUG

Utility

for 8086 and 8088 Microprocessors



System Requirements

The Microsoft DEBUG Utility requires:

A memory minimum that is program-dependent:

 13K bytes for code

 Run space is program-dependent

Disk drive(s):

 1 disk drive if and only if output is sent to the same physical disk from which the input was taken.
 Microsoft DEBUG does not allow time to swap disks during operation on a one-drive configuration.
 Therefore, two disk drives is a more practical configuration.



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CHAPTER 1

INTRODUCTION

1.1 OVERVIEW OF DEBUG

The Microsoft DEBUG Utility (DEBUG) is a debugging program that provides a controlled testing environment for binary and executable object files. Note that EDLIN is used to alter source files; DEBUG is EDLIN's counterpart for binary files. DEBUG eliminates the need to reassemble a program to see if a problem has been fixed by a minor change. It allows you to alter the contents of a file or the contents of a CPU register, and then to immediately reexecute a program to check on the validity of the changes.

All DEBUG commands may be aborted at any time by pressing <CONTROL-C>. <CONTROL-S> suspends the display, so that you can read it before the output scrolls away. Entering any key other than <CONTROL-C> or <CONTROL-S> restarts the display. All of these commands are consistent with the control character functions available at the MS-DOS command level.

1.2 HOW TO START DEBUG

DEBUG may be started two ways. By the first method, you type all commands in response to the DEBUG prompt (a hyphen). By the second method, you type all commands on the line used to start DEBUG.

Summary of Methods to Start DEBUG

=====

Method 1 DEBUG

Method 2 DEBUG]<filespec>]<arglist>[[

=====

1.2.1 Method 1: DEBUG

To start DEBUG using method 1, type:

```
DEBUG
```

DEBUG responds with the hyphen (-) prompt, signaling that it is ready to accept your commands. Since no filename has been specified, current memory, disk sectors, or disk files can be worked on by using other commands.

Warnings

1. When DEBUG (Version 2.0) is started, it sets up a program header at offset 0 in the program work area. On previous versions of DEBUG, you could overwrite this header. You can still overwrite the default header if no <filespec> is given to DEBUG. If you are debugging a .COM or .EXE file, however, do not tamper with the program header below address 5CH, or DEBUG will terminate.
2. Do not restart a program after the "Program terminated normally" message is displayed. You must reload the program with the N and L commands for it to run properly.

1.2.2 Method 2: Command Line

To start DEBUG using a command line, type:

```
DEBUG ]<filespec> ]<arglist>[
```

For example, if a <filespec> is specified, then the following is a typical command to start DEBUG:

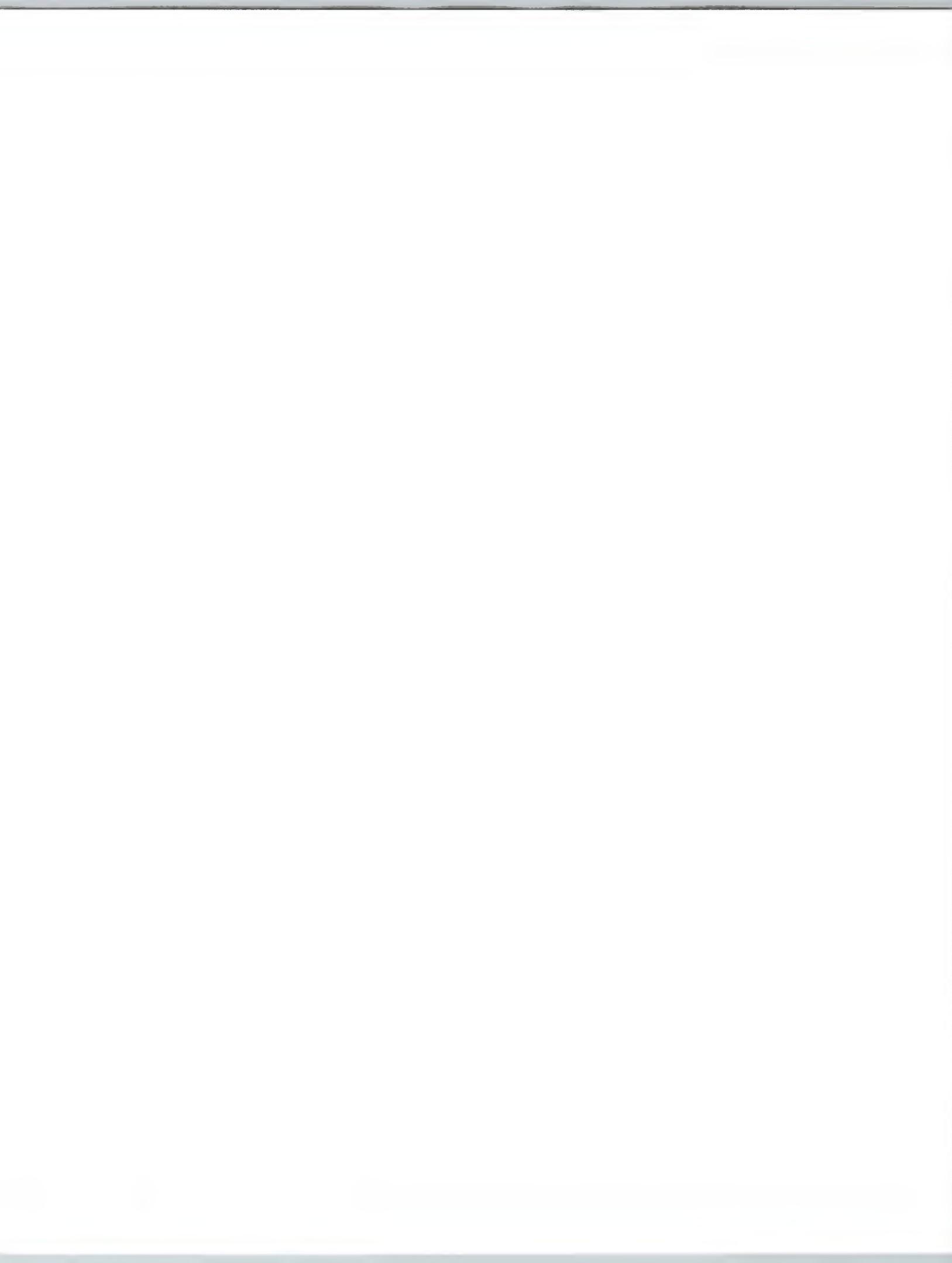
```
DEBUG FILE.EXE
```

DEBUG then loads FILE.EXE into memory starting at 100 hexadecimal in the lowest available segment. The BX:CX registers are loaded with the number of bytes placed into memory.

An <arglist> may be specified if <filespec> is present. The <arglist> is a list of filename parameters and switches that are to be passed to the program <filespec>. Thus, when <filespec> is loaded into memory, it is loaded as if it had been started with the command:

<filespec> <arglist>

Here, <filespec> is the file to be debugged, and the <arglist> is the rest of the command line that is used when <filespec> is invoked and loaded into memory.



CHAPTER 2

COMMANDS

2.1 COMMAND INFORMATION

Each DEBUG command consists of a single letter followed by one or more parameters. Additionally, the control characters and the special editing functions described in the MS-DOS User's Guide, apply inside DEBUG.

If a syntax error occurs in a DEBUG command, DEBUG reprints the command line and indicates the error with an up-arrow (^) and the word "error."

For example:

```
dcs:100 cs:110
      ^ error
```

Any combination of uppercase and lowercase letters may be used in commands and parameters.

The DEBUG commands are summarized in Table 2.1 and are described in detail, with examples, following the description of command parameters.

Table 2.1 DEBUG Commands

DEBUG Command	Function
A]<address>[	Assemble
C<range> <address>	Compare
D]<range>[	Dump
E<address>]<list>[	Enter
F<range> <list>	Fill
G]=[<address>]<address>...[[	Go
H<value> <value>	Hex
I<value>	Input
L]<address>]<drive><record><record>[[	Load
M<range> <address>	Move
N<filename>]<filename>[	Name
O<value> <byte>	Output
Q	Quit
R]<register-name>[	Register
S<range> <list>	Search
T]=[<address>[] <value>[	Trace
U]<range>[	Unassemble
W]<address>]<drive><record><record>[[	Write

2.2 PARAMETERS

All DEBUG commands accept parameters, except the Quit command. Parameters may be separated by delimiters (spaces or commas), but a delimiter is required only between two consecutive hexadecimal values. Thus, the following commands are equivalent:

```
dcs:100 110  
d cs:100 110  
d,cs:100,110
```

PARAMETER	DEFINITION
<drive>	A one-digit hexadecimal value to indicate which drive a file will be loaded from or written to. The valid values are 0-3. These values designate the drives as follows: 0=A:, 1=B:, 2=C:, 3=D:.
<byte>	A two-digit hexadecimal value to be placed in or read from an address or register.
<record>	A 1- to 3-digit hexadecimal value used to indicate the logical record number on the disk and the number of disk sectors to be written or loaded. Logical records correspond to sectors. However, their numbering differs since they represent the entire disk space.
<value>	A hexadecimal value up to four digits used to specify a port number or the number of times a command should repeat its functions.
<address>	A two-part designation consisting of either an alphabetic segment register designation or a four-digit segment address plus an offset value. The segment designation or segment address may be omitted, in which case the default segment is used. DS is the default segment for all commands except G, L, T, U, and W, for which the default segment is CS. All numeric values are hexadecimal.

For example:

```
CS:0100  
04BA:0100
```

The colon is required between a segment designation (whether numeric or alphabetic) and an offset.

<range> Two <address>es: e.g., <address> <address>; or one <address>, an L, and a <value>; e.g., <address> L <value> where <value> is the number of lines the command should operate on, and L80 is assumed. The last form cannot be used if another hex value follows the <range>, since the hex value would be interpreted as the second <address> of the <range>.

Examples:

```
CS:100 110  
CS:100 L 10  
CS:100
```

The following is illegal:

```
CS:100 CS:110  
      ^ error
```

The limit for <range> is 10000 hex. To specify a <value> of 10000 hex within four digits, type 0000 (or 0).

<list> A series of <byte> values or of <string>s. <list> must be the last parameter on the command line.

Example:

```
fcs:100 42 45 52 54 41
```

<string> Any number of characters enclosed in quote marks. Quote marks may be either single ('') or double("). If the delimiter quote marks must appear within a <string>, the quote marks must be doubled. For example, the following strings are legal:

```
'This is a "string" is okay.'  
'This is a ''string'' is okay.'
```

However, this string is illegal:

```
'This is a 'string' is not.'
```

Similarly, these strings are legal:

```
"This is a 'string' is okay."  
"This is a ""string"" is okay."
```

However, this string is illegal:

"This is a "string" is not."

Note that the double quote marks are not necessary in the following strings:

"This is a ''string'' is not necessary."
'This is a ""string"" is not necessary.'

The ASCII values of the characters in the string are used as a <list> of byte values.

NAME

Assemble

PURPOSE

Assembles 8086/8087/8088 mnemonics directly into memory.

SYNTAX

A]<address>[

COMMENTS

If a syntax error is found, DEBUG responds with
^Error

and redisplays the current assembly address.

All numeric values are hexadecimal and must be entered as 1-4 characters. Prefix mnemonics must be specified in front of the opcode to which they refer. They may also be entered on a separate line.

The segment override mnemonics are CS:, DS:, ES:, and SS:. The mnemonic for the far return is RETF. String manipulation mnemonics must explicitly state the string size. For example, use MOVSW to move word strings and MOVSB to move byte strings.

The assembler will automatically assemble short, near or far jumps and calls, depending on byte displacement to the destination address. These may be overridden with the NEAR or FAR prefix. For example:

```
0100:0500 JMP 502 ; a 2-byte short jump
0100:0502 JMP NEAR 505 ; a 3-byte near jump
0100:505 JMP FAR 50A ; a 5-byte far jump
```

The NEAR prefix may be abbreviated to NE, but the FAR prefix cannot be abbreviated.

DEBUG cannot tell whether some operands refer to a word memory location or to a byte memory location. In this case, the data type must be explicitly stated with the prefix "WORD PTR" or "BYTE PTR". Acceptable abbreviations are "WO" and "BY". For example:

```
NEG BYTE PTR ]128[
DEC WO ]SI[
```

DEBUG also cannot tell whether an operand refers to a memory location or to an immediate operand. DEBUG uses the common convention that operands enclosed in square brackets refer to memory. For example:

```
MOV     AX,21           ; Load AX with 21H  
MOV     AX,]21[          ; Load AX with the  
                        ; contents  
                        ; of memory location 21H
```

Two popular pseudo-instructions are available with Assemble. The DB opcode will assemble byte values directly into memory. The DW opcode will assemble word values directly into memory. For example:

```
DB      1,2,3,4,"THIS IS AN EXAMPLE"  
DB      'THIS IS A QUOTE: "'  
DB      "THIS IS A QUOTE: '"  
  
DW      1000,2000,3000,"BACH"
```

Assemble supports all forms of register indirect commands. For example:

```
ADD    BX,34]BP+2[.]SI-1[  
POP    ]BP+DI[  
PUSH   ]SI[
```

All opcode synonyms are also supported. For example:

```
LOOPZ  100  
LOOPE  100  
  
JA     200  
JNBE  200
```

For 8087 opcodes, the WAIT or FWAIT must be explicitly specified. For example:

```
FWAIT FADD ST,ST(3)    ; This line will assemble  
                        ; an FWAIT prefix  
LD TBYTE PTR ]BX[      ; This line will not
```

NAME**Compare****PURPOSE**

Compares the portion of memory specified by <range> to a portion of the same size beginning at <address>.

SYNTAX**C<range> <address>****COMMENTS**

If the two areas of memory are identical, there is no display and DEBUG returns with the MS-DOS prompt. If there are differences, they are displayed in this format:

<address1> <byte1> <byte2> <address2>**EXAMPLE**

The following commands have the same effect:

C100,1FF 300**or****C100L100 300**

Each command compares the block of memory from 100 to 1FFH with the block of memory from 300 to 3FFH.

NAME

Dump

PURPOSE

Displays the contents of the specified region of memory.

SYNTAX

D]<range>[

COMMENTS

If a range of addresses is specified, the contents of the range are displayed. If the D command is typed without parameters, 128 bytes are displayed at the first address (DS:100) after the address displayed by the previous Dump command.

The dump is displayed in two portions: a hexadecimal dump (each byte is shown in hexadecimal value) and an ASCII dump (the bytes are shown in ASCII characters). Nonprinting characters are denoted by a period (.) in the ASCII portion of the display. Each display line shows 16 bytes with a hyphen between the eighth and ninth bytes. At times, displays are split in this manual to fit them on the page. Each displayed line begins on a 16-byte boundary.

If you type the command:

dcs:100 110

DEBUG displays the dump in the following format:

04BA:0100 42 45 52 54 41 ... 4E 44 TOM SAWYER

If you type the following command:

D

the display is formatted as described above. Each line of the display begins with an address, incremented by 16 from the address on the previous line. Each subsequent D (typed without parameters) displays the bytes immediately following those last displayed.

If you type the command:

DCS:100 L 20

the display is formatted as described above,
but 20H bytes are displayed.

If then you type the command:

DCS:100 115

the display is formatted as described above,
but all the bytes in the range of lines from
100H to 115H in the CS segment are displayed.

NAME**Enter****PURPOSE**

Enters byte values into memory at the specified <address>.

SYNTAX

E<address>] <list>[

COMMENTS

If the optional <list> of values is typed, the replacement of byte values occurs automatically. (If an error occurs, no byte values are changed.)

If the <address> is typed without the optional <list>, DEBUG displays the address and its contents, then repeats the address on the next line and waits for your input. At this point, the Enter command waits for you to perform one of the following actions:

1. Replace a byte value with a value you type. Simply type the value after the current value. If the value typed in is not a legal hexadecimal value or if more than two digits are typed, the illegal or extra character is not echoed.
2. Press the <SPACE> bar to advance to the next byte. To change the value, simply type the new value as described in (1.) above. If you space beyond an 8-byte boundary, DEBUG starts a new display line with the address displayed at the beginning.
3. Type a hyphen (-) to return to the preceding byte. If you decide to change a byte behind the current position, typing the hyphen returns the current position to the previous byte. When the hyphen is typed, a new line is started with the address and its byte value displayed.
4. Press the <RETURN> key to terminate the Enter command. The <RETURN> key may be pressed at any byte position.

EXAMPLE

Assume that the following command is typed:

ECS:100

DEBUG displays:

04BA:0100 EB._

To change this value to 41, type 41 as shown:

04BA:0100 EB.41_

To step through the subsequent bytes, press the <SPACE> bar to see:

04BA:0100 EB.41 10. 00. BC._

To change BC to 42:

04BA:0100 EB.41 10. 00. BC.42_

Now, realizing that 10 should be 6F, type the hyphen as many times as needed to return to byte 0101 (value 10), then replace 10 with 6F:

04BA:0100 EB.41 10. 00. BC.42-

04BA:0102 00.-

04BA:0101 10.6F_

Pressing the <RETURN> key ends the Enter command and returns to the DEBUG command level.

NAME

Fill

PURPOSE

Fills the addresses in the <range> with the values in the <list>.

SYNTAX

F<range> <list>

COMMENTS

If the <range> contains more bytes than the number of values in the <list>, the <list> will be used repeatedly until all bytes in the <range> are filled. If the <list> contains more values than the number of bytes in the <range>, the extra values in the <list> will be ignored. If any of the memory in the <range> is not valid (bad or nonexistent), the error will occur in all succeeding locations.

EXAMPLE

Assume that the following command is typed:

F04BA:100 L 100 42 45 52 54 41

DEBUG fills memory locations 04BA:100 through 04BA:1FF with the bytes specified. The five values are repeated until all 100H bytes are filled.

NAME

Go

PURPOSE

Executes the program currently in memory.

SYNTAX

G]=[<address>] <address>...[[

COMMENTS

If only the Go command is typed, the program executes as if the program had run outside DEBUG.

If =<address> is set, execution begins at the address specified. The equal sign (=) is required, so that DEBUG can distinguish the start =<address> from the breakpoint <address>es.

With the other optional addresses set, execution stops at the first <address> encountered, regardless of that address' position in the list of addresses to halt execution or program branching. When program execution reaches a breakpoint, the registers, flags, and decoded instruction are displayed for the last instruction executed. (The result is the same as if you had typed the Register command for the breakpoint address.)

Up to ten breakpoints may be set. Breakpoints may be set only at addresses containing the first byte of an 8086 opcode. If more than ten breakpoints are set, DEBUG returns the BP Error message.

The user stack pointer must be valid and have 6 bytes available for this command. The G command uses an IRET instruction to cause a jump to the program under test. The user stack pointer is set, and the user flags, Code Segment register, and Instruction Pointer are pushed on the user stack. (Thus, if the user stack is not valid or is too small, the operating system may crash.) An interrupt code (0CCH) is placed at the specified breakpoint address(es).

When an instruction with the breakpoint code is encountered, all breakpoint addresses are restored to their original instructions. If

execution is not halted at one of the breakpoints, the interrupt codes are not replaced with the original instructions.

EXAMPLE

Assume that the following command is typed:

GCS:7550

The program currently in memory executes up to the address 7550 in the CS segment. DEBUG then displays registers and flags, after which the Go command is terminated.

After a breakpoint has been encountered, if you type the Go command again, then the program executes just as if you had typed the filename at the MS-DOS command level. The only difference is that program execution begins at the instruction after the breakpoint rather than at the usual start address.

NAME

Hex

PURPOSE

Performs hexadecimal arithmetic on the two parameters specified.

SYNTAX

H<value> <value>

COMMENTS

First, DEBUG adds the two parameters, then subtracts the second parameter from the first. The results of the arithmetic are displayed on one line; first the sum, then the difference.

EXAMPLE

Assume that the following command is typed:

H19F 10A

DEBUG performs the calculations and then displays the result:

02A9 0095

NAME**Input****PURPOSE****Inputs and displays one byte from the port specified by <value>.****SYNTAX****I<value>****COMMENTS****A 16-bit port address is allowed.****EXAMPLE****Assume that you type the following command:****I2F8****Assume also that the byte at the port is 42H.
DEBUG inputs the byte and displays the value:****42**

NAME

Load

PURPOSE

Loads a file into memory.

SYNTAX

L]<address>]<drive> <record> <record>[[

COMMENTS

Set BX:CX to the number of bytes read. The file must have been named either when DEBUG was started or with the N command. Both the DEBUG invocation and the N command format a filename properly in the normal format of a file control block at CS:5C.

If the L command is typed without any parameters, DEBUG loads the file into memory beginning at address CS:100 and sets BX:CX to the number of bytes loaded. If the L command is typed with an address parameter, loading begins at the memory <address> specified. If L is typed with all parameters, absolute disk sectors are loaded, not a file. The <records>s are taken from the <drive> specified (the drive designation is numeric here--0=A:, 1=B:, 2=C:, etc.); DEBUG begins loading with the first <record> specified, and continues until the number of sectors specified in the second <record> have been loaded.

EXAMPLE

Assume that the following commands are typed:

```
A>DEBUG  
-NFILE.COM
```

Now, to load FILE.COM, type:

L

DEBUG loads the file and then displays the DEBUG prompt. Assume that you want to load only portions of a file or certain records from a disk. To do this, type:

L04BA:100 2 0F 6D

DEBUG then loads 109 (6D hex) records beginning with logical record number 15 into memory

beginning at address 04BA:0100. When the records have been loaded, DEBUG simply returns the - prompt.

If the file has a .EXE extension, it is relocated to the load address specified in the header of the .EXE file: the <address> parameter is always ignored for .EXE files. The header itself is stripped off the .EXE file before it is loaded into memory. Thus the size of an .EXE file on disk will differ from its size in memory.

If the file named by the Name command or specified when DEBUG is started is a .HEX file, then typing the L command with no parameters causes DEBUG to load the file beginning at the address specified in the .HEX file. If the L command includes the option <address>, DEBUG adds the <address> specified in the L command to the address found in the .HEX file to determine the start address for loading the file.

NAME

Move

PURPOSE

Moves the block of memory specified by <range> to the location beginning at the <address> specified.

SYNTAX

M<range> <address>

COMMENTS

Overlapping moves (i.e., moves where part of the block overlaps some of the current addresses) are always performed without loss of data. Addresses that could be overwritten are moved first. The sequence for moves from higher addresses to lower addresses is to move the data beginning at the block's lowest address and then to work towards the highest. The sequence for moves from lower addresses to higher addresses is to move the data beginning at the block's highest address and to work towards the lowest.

Note that if the addresses in the block being moved will not have new data written to them, the data there before the move will remain. The M command copies the data from one area into another, in the sequence described, and writes over the new addresses. This is why the sequence of the move is important.

EXAMPLE

Assume that you type:

MCS:100 110 CS:500

DEBUG first moves address CS:110 to address CS:510, then CS:10F to CS:50F, and so on until CS:100 is moved to CS:500. You should type the D command, using the <address> typed for the M command, to review the results of the move.

NAME

Name

PURPOSE

Sets filenames.

SYNTAX

N<filename>]<filename>...[

COMMENTS

The Name command performs two functions. First, Name is used to assign a filename for a later Load or Write command. Thus, if you start DEBUG without naming any file to be debugged, then the N<filename> command must be typed before a file can be loaded. Second, Name is used to assign filename parameters to the file being debugged. In this case, Name accepts a list of parameters that are used by the file being debugged.

These two functions overlap. Consider the following set of DEBUG commands:

```
-NFILE1.EXE  
-L  
-G
```

Because of the effects of the Name command, Name will perform the following steps:

1. (N)ame assigns the filename FILE1.EXE to the filename to be used in any later Load or Write commands.
2. (N)ame also assigns the filename FILE1.EXE to the first filename parameter used by any program that is later debugged.
3. (L)oad loads FILE1.EXE into memory.
4. (G)o causes FILE1.EXE to be executed with FILE1.EXE as the single filename parameter (that is, FILE1.EXE is executed as if FILE1.EXE had been typed at the command level).

A more useful chain of commands might look like this:

```
-NFILE1.EXE  
-L  
-NFILE2.DAT FILE3.DAT  
-G
```

Here, Name sets FILE1.EXE as the filename for the subsequent Load command. The Load command loads FILE1.EXE into memory, and then the Name command is used again, this time to specify the parameters to be used by FILE1.EXE. Finally, when the Go command is executed, FILE1.EXE is executed as if FILE1 FILE2.DAT FILE3.DAT had been typed at the MS-DOS command level. Note that if a Write command were executed at this point, then FILE1.EXE--the file being debugged--would be saved with the name FILE2.DAT! To avoid such undesired results, you should always execute a Name command before either a Load or a Write.

There are four regions of memory that can be affected by the Name command:

```
CS:5C FCB for file 1  
CS:6C FCB for file 2  
CS:80 Count of characters  
CS:81 All characters typed
```

A File Control Block (FCB) for the first filename parameter given to the Name command is set up at CS:5C. If a second filename parameter is typed, then an FCB is set up for it beginning at CS:6C. The number of characters typed in the Name command (exclusive of the first character, "N") is given at location CS:80. The actual stream of characters given by the Name command (again, exclusive of the letter "N") begins at CS:81. Note that this stream of characters may contain switches and delimiters that would be legal in any command typed at the MS-DOS command level.

EXAMPLE

A typical use of the Name command is:

```
DEBUG PROG.COM  
-NPARAM1 PARAM2/C  
-G  
-
```

In this case, the Go command executes the file in memory as if the following command line had been typed:

PROG PARAM1 PARAM2/C

Testing and debugging therefore reflect a normal runtime environment for PROG.COM.

NAME**Output****PURPOSE****Sends the <byte> specified to the output port specified by <value>.****SYNTAX****O<value> <byte>****COMMENTS****A 16-bit port address is allowed.****EXAMPLE****Type:****02F8 4F****DEBUG outputs the byte value 4F to output port 2F8.**

NAME

Quit

PURPOSE

Terminates the DEBUG utility.

SYNTAX

Q

COMMENTS

The Q command takes no parameters and exits DEBUG without saving the file currently being operated on. You are returned to the MS-DOS command level.

EXAMPLE

To end the debugging session, type:

Q<RETURN>

DEBUG has been terminated, and control returns to the MS-DOS command level.

NAME**Register****PURPOSE**

Displays the contents of one or more CPU registers.

SYNTAX

R]<register-name>[

COMMENTS

If no <register-name> is typed, the R command dumps the register save area and displays the contents of all registers and flags.

If a register name is typed, the 16-bit value of that register is displayed in hexadecimal, and then a colon appears as a prompt. You then either type a <value> to change the register, or simply press the <RETURN> key if no change is wanted.

The only valid <register-name>s are:

AX	BP	SS
BX	SI	CS
CX	DI	IP (IP and PC both refer
DX	DS	to the Instruction
SP	ES	Pointer.)

Any other entry for <register-name> results in a BR Error message.

If F is entered as the <register-name>, DEBUG displays each flag with a two-character alphabetic code. To alter any flag, type the opposite two-letter code. The flags are either set or cleared.

The flags are listed below with their codes for SET and CLEAR:

FLAG NAME	SET	CLEAR
Overflow	OV	NV
Direction	DN Decrement	UP Increment
Interrupt	EI Enabled	DI Disabled
Sign	NG Negative	PL Plus
Zero	ZR	NZ
Auxiliary Carry	AC	NA
Parity	PE Even	PO Odd
Carry	CY	NC

Whenever you type the command RF, the flags are displayed in the order shown above in a row at the beginning of a line. At the end of the list of flags, DEBUG displays a hyphen (-). You may enter new flag values as alphabetic pairs. The new flag values can be entered in any order. You do not have to leave spaces between the flag entries. To exit the R command, press the <RETURN> key. Flags for which new values were not entered remain unchanged.

If more than one value is entered for a flag, DEBUG returns a DF Error message. If you enter a flag code other than those shown above, DEBUG returns a BF Error message. In both cases, the flags up to the error in the list are changed; flags at and after the error are not.

At startup, the segment registers are set to the bottom of free memory, the Instruction Pointer is set to 0100H, all flags are cleared, and the remaining registers are set to zero.

EXAMPLE

Type:

R

DEBUG displays all registers, flags, and the decoded instruction for the current location. If the location is CS:11A, then the display will look similar to this:

```
AX=0E00 BX=00FF CX=0007 DX=01FF SP=039D BP=0000
SI=005C DI=0000 DS=04BA ES=04BA SS=04BA CS=04BA
IP=011A NV UP DI NG NZ AC PE NC
04BA:011A CD21           INT    21
```

If you type:

RF

DEBUG will display the flags:

```
NV UP DI NG NZ AC PE NC - _
```

Now, type any valid flag designation, in any order, with or without spaces.

For example:

```
NV UP DI NG NZ AC PE NC - PLEICY<RETURN>
```

DEBUG responds only with the DEBUG prompt. To see the changes, type either the R or RF command:

RF

```
NV UP EI PL NZ AC PE CY - _
```

Press <RETURN> to leave the flags this way, or to specify different flag values.

NAME**Search****PURPOSE**

Searches the <range> specified for the <list> of bytes specified.

SYNTAX**S<range> <list>****COMMENTS**

The <list> may contain one or more bytes, each separated by a space or comma. If the <list> contains more than one byte, only the first address of the byte string is returned. If the <list> contains only one byte, all addresses of the byte in the <range> are displayed.

EXAMPLE

If you type:

SCS:100 110 41

DEBUG will display a response similar to this:

04BA:0104
04BA:010D
-type:

NAME

Trace

PURPOSE

Executes one instruction and displays the contents of all registers and flags, and the decoded instruction.

SYNTAX

T]=[<address> [] <value> [

COMMENTS

If the optional =<address> is typed, tracing occurs at the =<address> specified. The optional <value> causes DEBUG to execute and trace the number of steps specified by <value>.

The T command uses the hardware trace mode of the 8086 or 8088 microprocessor. Consequently, you may also trace instructions stored in ROM (Read Only Memory).

EXAMPLE

Type:

T

DEBUG returns a display of the registers, flags, and decoded instruction for that one instruction. Assume that the current position is 04BA:011A; DEBUG might return the display:

```
AX=0E00 BX=00FF CX=0007 DX=01FF SP=039D BP=0000
SI=005C DI=0000 DS=04BA ES=04BA SS=04BA CS=04BA
IP=011A NV UP DI NG NZ AC PE NC
04BA:011A CD21           INT      21
```

If you type

```
T=011A 10
```

DEBUG executes sixteen (10 hex) instructions beginning at 011A in the current segment, and then displays all registers and flags for each instruction as it is executed. The display scrolls away until the last instruction is executed. Then the display stops, and you can see the register and flag values for the last few instructions performed. Remember that <CONTROL-S> suspends the display at any point, so that you can study the registers and flags for any instruction.

NAME

Unassemble

PURPOSE

Disassembles bytes and displays the source statements that correspond to them, with addresses and byte values.

SYNTAX

U]<range>[

COMMENTS

The display of disassembled code looks like a listing for an assembled file. If you type the U command without parameters, 20 hexadecimal bytes are disassembled at the first address after that displayed by the previous Unassemble command. If you type the U command with the <range> parameter, then DEBUG disassembles all bytes in the range. If the <range> is given as an <address> only, then 20H bytes are disassembled instead of 80H.

EXAMPLE

Type:

U04BA:100 L10

DEBUG disassembles 16 bytes beginning at address 04BA:0100:

04BA:0100	206472	AND	]SI+72[,AH
04BA:0103	69	DB	69
04BA:0104	7665	JBE	016B
04BA:0106	207370	AND	]BP+DI+70[,DH
04BA:0109	65	DB	65
04BA:010A	63	DB	63
04BA:010B	69	DB	69
04BA:010C	66	DB	66
04BA:010D	69	DB	69
04BA:010E	63	DB	63
04BA:010F	61	DB	61

If you type

U04ba:0100 0108

The display will show:

```
04BA:0100  206472      AND  ]SI+72[,AH  
04BA:0103  69          DB   69  
04BA:0104  7665        JBE  016B  
04BA:0106  207370      AND  ]BP+DI+70[,DH
```

If the bytes in some addresses are altered, the disassembler alters the instruction statements. The U command can be typed for the changed locations, the new instructions viewed, and the disassembled code used to edit the source file.

NAME

Write

PURPOSE

Writes the file being debugged to a disk file.

SYNTAX

W]<address>] <drive> <record> <record>[[

COMMENTS

If you type W with no parameters, BX:CX must already be set to the number of bytes to be written; the file is written beginning from CS:100. If the W command is typed with just an address, then the file is written beginning at that address. If a G or T command has been used, BX:CX must be reset before using the Write command without parameters. Note that if a file is loaded and modified, the name, length, and starting address are all set correctly to save the modified file (as long as the length has not changed).

The file must have been named either with the DEBUG invocation command or with the N command (refer to the Name command earlier in this manual). Both the DEBUG invocation and the N command format a filename properly in the normal format of a file control block at CS:5C.

If the W command is typed with parameters, the write begins from the memory address specified; the file is written to the <drive> specified (the drive designation is numeric here--0=A:, 1=B:, 2=C:, etc.); DEBUG writes the file beginning at the logical record number specified by the first <record>; DEBUG continues to write the file until the number of sectors specified in the second <record> have been written.

WARNING

Writing to absolute sectors is EXTREMELY dangerous because the process bypasses the file handler.

EXAMPLE

Type:

W

DEBUG will write the file to disk and then display the DEBUG prompt. Two examples are shown below.

W

--

WCS:100 1 37 2B

DEBUG writes out the contents of memory, beginning with the address CS:100 to the disk in drive B:. The data written out starts in disk logical record number 37H and consists of 2BH records. When the write is complete, DEBUG displays the prompt:

WCS:100 1 37 2B

--

2.3 ERROR MESSAGES

During the DEBUG session, you may receive any of the following error messages. Each error terminates the DEBUG command under which it occurred, but does not terminate DEBUG itself.

ERROR CODE	DEFINITION
BF	Bad flag
BP	Too many breakpoints
BR	Bad register
DF	Double flag

You attempted to alter a flag, but the characters typed were not one of the acceptable pairs of flag values. See the Register command for the list of acceptable flag entries.

You specified more than ten breakpoints as parameters to the G command. Retype the Go command with ten or fewer breakpoints.

You typed the R command with an invalid register name. See the Register command for the list of valid register names.

You typed two values for one flag. You may specify a flag value only once per RF command.

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1114 Industry Dr. Seattle WA 98188 206/575-1830

Seattle Computer Small Assembler

Utility

Seattle's
Assembler

Preliminary



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Seattle Computer Small Assembler

Utility

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Drive, Seattle, WA 98188.

Part Number 900-001999

System Requirements

The Seattle Computer Products Smaller Assembler requires:

17K bytes of memory minimum:

 8K bytes for code

 9k bytes for run space



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GENERAL INTRODUCTION

The Seattle Computer Products Small Assembler Manual describes the Small Assembler, which is smaller and faster than the Microsoft Macro Assembler.

Major Features

Small Assembler (ASM) Utility

The Small Assembler is smaller and faster than Microsoft's Macro Assembler

The Small Assembler has full 8087 opcode support

Hexadecimal-to-Binary Conversion (HEX2BIN) Utility

Converts files produced by ASM (in Intex hex format) to binary format

Z80-to-8086 Translator (TRANS) Utility

Translates Z80 source file to an 8086 source file usable by ASM.

CHAPTER 1

INTRODUCTION

The Small Assembler (ASM) is an alternative to Microsoft's Macro Assembler. ASM is much smaller and faster, but has far fewer features as well (no macros, for example). It is recommended for smaller assembly-language jobs. Also, the Z80-to-8086 translator produces this format.

ASM uses a syntax slightly different from the Microsoft Macro Assembler and Intel's ASM-86. It is not strongly typed, which means that sometimes an explicit type designator is required. For the 8086-only subset, B is used for byte operations, W for word. When also programming the 8087, S is used for short (32-bit), L for long (64-bit), and T for 10-byte (temporary real). While almost all mnemonics are the same, Section 3.1 ("Operands") should be carefully reviewed for other differences.

The 8086 architecture or instruction set are not described here. Intel reference manuals will be required for this, such as the iAPX 86,88 User's Manual, available from many computer dealers.

System Requirements

The Seattle Computer Products Smaller Assembler requires:

17K bytes of memory minimum:

8K bytes for code

9k bytes for run space

CHAPTER 2

CALLING THE ASSEMBLER

2.1 ASM COMMAND

The assembler is invoked with the command:

```
ASM <filename.ASM>
```

which will assemble the 8086 source file named FILENAME.ASM. The ASM extension is always assumed and may not be overridden. This is the simplest form of the command. It assumes filename.ASM resides on the default drive, and will write the Intel hex object file, named filename.HEX, and the assembler listing, filename.PRN, to the default drive.

The first variation of this form is to precede the filename with a drive specifier and a colon, such as:

```
ASM B:<filename>
```

which causes the specified drive to be searched for the source file, but the object and listing files will still be written to the default drive.

The most general form is:

```
ASM <filename.drive-assignment>
```

The drive-assignment is a 3-letter extension not related to the actual extension to the source file, which is always ASM. Instead, it is used as follows:

- o The first letter is the name of the drive on which the source file will be found. This overrides a disk specifier which precedes the file name ("B:").
- o The second letter is the name of the drive to which the hex object file will be written, or "Z" if no object file is desired.

- The third letter is the name of the drive to which the listing file will be written, or one of the following special characters:

P Send the listing directly to the printer (TABs are NOT expanded). Lines with errors and their error messages are still displayed on the console.

X Send the listing to the console.

Y No listing file is produced, except that lines with errors and their error messages are displayed on the console.

Z No listing file is desired. Error messages are still sent to the console, including address and line number in error, but the actual source text of the line in error is not listed. This option is much faster than any of the others since the source file is not read from disk a second time. Since it provides less diagnostics than the other options, it is normally used only if you are assembling a file which probably has no errors in it.

If a listing is selected, then an alphabetical symbol table dump may be appended to it by typing "S" after the file name and extension.

Examples:

```
ASM filename.ABA
    Source - Drive A
    Object - Drive B
    Listing - Drive A
```

```
ASM filename.AAZ
    Source - Drive A
    Object - Drive A
    No Listing
```

```
ASM filename.BZX S
    Source - Drive B
    Object - None
    Listing (with symbol table dump) - Console
```

2.2 ERROR MESSAGES

Several errors will cause the assembler to print an error message and abort:

FILE NOT FOUND

The source file was not found on the specified disk.
Probably a misspelling or wrong disk.

BAD DISK SPECIFIER

The file name's extension contained an illegal character. Only A-O and possibly P, X, Y or Z are legal.

NO DIRECTORY SPACE

The object or listing file could not be created.

DISK WRITE ERROR

Probably insufficient space on disk for object or listing files.

INSUFFICIENT MEMORY

Memory requirements increase with source program size due to storage required by the symbol table and by the intermediate code. Requirements can be reduced by using shorter labels, by defining labels before they are used, and by reducing the total number of program lines.



CHAPTER 3

SOURCE PROGRAM FORMAT

Input to the assembler is a sequence of lines, where each line is terminated with an ASCII carriage return and linefeed characters. The assembler accepts lines of any length, but does no list formatting, so line length may be limited by your list device. Upper and lower case characters are equivalent and may be mixed freely.

Each line may include up to four fields, which may be separated from each other by any number of spaces or tabs (control-I). Fields must appear in order, as follows:

1. **Label field (optional)** - If present, it must either begin with the first character on the line or be followed immediately by a colon. A label begins with a letter and may be followed by any number of letters or digits, up to a total length of 80 characters, all of which are significant.
2. **Opcode field (optional)** - If present, it must begin after the first character on the line (otherwise it would be mistaken for a label).
3. **Operand field** - This field is present only as required by the opcode field.
4. **Comment field (optional)** - If present, it must begin with a semicolon (;).

Since all fields are optional, lines may be blank, may have labels only, may have comments only, etc.

Bus lock (LOCK), string repeat (REP), and segment override (SEG) prefixes are treated as separate opcodes and must appear on the line preceding the opcode they are to prefix.

3.1 OPERANDS

Each operand is one of the following types:

- A register
- A value
- An address

3.1.1 Register Operands

The 8086 registers are listed below:

AX, BX, CX, DX, AL, AH, BL, BH, CL, CH, DL, DH, SI, DI,
SP, BP, CS, DS, ES, SS

The 8087 registers are:

ST(0) through ST(7)

where ST(0) may be referred to as simply ST.

Most instructions have limitations on which registers may be used.

3.1.2 Value Operands

A value operand is an expression involving constants or labels. The operators may be:

- * Multiplication
- / Division
- + Addition
- Subtraction

Multiplication and division have their usual higher precedence over addition and subtraction, but order of evaluation may be forced with parentheses.

Terms of the expression may be:

A decimal constant

Example: 486

A hex constant

A hex constant which must begin with a digit from 0 to 9 and end with an H

Example: 0F9H

A string constant

In general, this is any number of characters enclosed by either single ('') or double ("") quotes. Since the opening and closing quotes must be the same, the other type may appear in the string freely. If the same quote that opened the string needs to appear within it, it must be given as two adjacent quotes.

"TEST" is the same as 'TEST'

"" is the same as ""

Control characters except control-Z (1AH) may appear in the string, but this may have a strange effect on the listing.

Note that multi-character strings are meaningful only for the DB, DM, and DW pseudo-ops. All other expressions are limited to one-character strings.

A label

No more than one undefined label may appear in an expression, and undefined labels may only be added. An undefined label is one which has not yet appeared in the label field as the source code is scanned from the beginning to the current line.

A dollar sign (\$)

This special symbol means the value of the location counter at the start of this instruction.

RET

This special symbol means "the address of a nearby RETurn instruction". This allows conditional returns without requiring a label to be put on the RETurn instruction.

Examples:

CMP	AL,20H
JC	RET

The jump instruction effectively means "return if carry", yet no label named RET need appear--in fact, a label would be ignored. If no RETurn instruction appears within the range of the jump, then a "value error", number 65 hex, will occur. Only RETurn instructions with no operands will be the target of the jump (intra-segment return without adding to stack pointer).

3.1.3 Address Operands

A valid 8086 address expression enclosed within brackets. For example:

[BP]

The address expression may be:

- A value, as defined above.
- A base register (BP or BX).
- An index register (SI or DI).
- The sum of any of the above, as limited by valid 8086 addressing modes.

3.1.4 Examples of Operands**Legal:**

```

-3+ 17H
SCOPE+4
[ BX + COUNT*2 ]           ;COUNT must have already been
                            defined
[SI+ARRAY+BX-OFFSET]       ;OFFSET must have already been
                            defined
[DI]
[ NEXT]

```

Illegal:

```

12+BX                      ;Register not allowed in value
9C01                        ;Needs trailing "H"
[COUNT - BX]                 ;Can't subtract register
[BX+BP]                      ;Only one base register at a
                             time
[ARRAY+BX+OFFSET]            ;Both labels are forward
                             referenced (Note 1)
COUNT-DIF                    ;DIF is forward referenced
                             (Note 2)

```

Note 1. This problem could be corrected like this:

```

MOV      AX,[BX + ARRAYPLUSOFFSET]
.
.
.
ARRAY:
.
.
.
OFFSET:
.
.
.
ARRAYPLUSOFFSET: EQU      ARRAY + OFFSET

```

Note 2. This problem could be corrected like this:

```

MOV      AX,COUNT + MINUSDIF
.
.
.
DIF:
.
.
.
MINUSDIF:EQU    -DIF

```

3.2 PSEUDO-OPS

ALIGN

ALIGN ensures that the next location counter address is even; that is, aligned on a word boundary. If the location counter is currently odd, both it and the PUT address are incremented; otherwise they are unchanged. See PUT and ORG below for an explanation of these terms.

DB value
DB value, value, value, . . . , value

DB (Define Byte) tells the assembler to reserve one or more bytes as data in the object code. Each value listed is placed in sequence in object code, where a multi-character string is equivalent to a sequence of one-character strings. Values must be in the range -256 to +255. Example:

```
DB      "Message in quotes",0DH,0AH,-1
```

DM value
DM value, value, value, . . . , value

DM (Define Message) is nearly identical to DB, except that the most significant bit (bit 7) of the last byte is set to one. This can be a convenient way to terminate an ASCII message since this bit would not otherwise be significant. Example:

```
DM      'Message in quotes',0DH,0AH
```

is equivalent to

DS DB 'Message in quotes',0DH,0AH+80H
 value

DS (Define Storage) is used to tell the assembler to reserve value bytes of the object code as storage. Any labels appearing in the expression for value must have already been defined.

DW value
DW value, value, value, . . . , value

DW (Define Word) is used to tell the assembler to reserve one or more 16-bit words as data in the object code. It is very similar to DB, except that each value occupies two bytes instead of one. Since a multi-character string is equivalent to a sequence of one-character strings,

DW 'TEST'

is equivalent to

DB 'T',0,'E',0,'S',0,'T',0

because the high byte of the 16-bit constant represented by 'T' is always zero.

LABEL: EQU value

EQU (Equate) assigns the value to the label. The label MUST be on the same line as the EQU. Three common uses of this operation are:

1. To assign a name to a constant, for convenience and documentation. For example:

CR:	EQU	13
LF:	EQU	10

The program could now refer to ASCII carriage return and linefeed with symbols CR and LF, respectively.

2. To "parameterize" a program. I/O ports and status bits, for example, could be set by equates at the beginning of the program. Then to reassemble the program for a different I/O system would require editing only these few lines at the beginning.
3. To bypass expressions that would have two or more undefined labels or that would subtract an undefined label. See examples under "Operands."

IF value
ENDIF

IF allows portions of the source code to be assembled only under certain conditions. Specifically, that portion of the source code between the IF and ENDIF will be assembled only if the operand is NOT zero. This is particularly useful when producing different versions of the same program. IFs may be nested up to 255 deep.

ORG value

ORG sets the assembler's location counter, which is subsequently incremented for each byte of code produced or space allocated. The value of the location counter should always be equal to the displacement from the beginning of the segment to the next byte of code or data, since it is used to establish the value of labels. ORG may be used any number of times in a program. Any labels appearing in the expression for "value" must have already been defined.

PUT value

The assembler writes object code to the disk in Intel hex format. This format includes information which specifies the addresses at which the object file will be later loaded into memory by a hex loader.

PUT is used to specify this load address. Initially, the load address is 100H, that is, "PUT 100H" is assumed before assembly begins. Each time a PUT occurs, all subsequent code would be loaded starting at the specified address until the next PUT is encountered. This allows modules to be placed in specific areas of memory. Note that the load address is not related to the location counter (see ORG), although PUTs and ORGs will often occur together. Any labels appearing in the expression for value must have already been defined.

3.3 8086 OPCODE CLASSIFICATIONS

Two-Operand ALU

ADC, ADD, AND, CMP, DIV, IDIV, IMUL, MOV, MUL, OR,
SBB, SBC, SUB, TEST, XCHG, XOR

Operand Forms:

reg,reg	Register to register
[addr],reg	Register to memory
reg,[addr]	Memory to register
reg,value	Immediate to register
B,[addr],value	Byte immediate to memory
W,[addr],value	Word immediate to memory
[addr],value	Immediate to memory defaults to word

Notes:

SBC is the same as SBB.

The order of operands for TEST and XCHG is irrelevant.

XCHG may not use immediate operands.

For DIV, IDIV, MUL, and IMUL, the first operand must be AL or AX and the second operand may not be immediate.

One-Operand ALU

DEC, INC, NEG, NOT, POP, PUSH

Operand Forms:

reg	Register
B, [addr]	Memory byte
W, [addr]	Memory word
[addr]	Default to word

Note:

POP and PUSH only operate on words.

Input/Output

IN, INB, INW, OUT, OUTB, OUTW

Operand Forms:

value	Input/output to fixed port
DX	Input/output to port number in DX

Notes:

IN, INB, OUT, OUTB transfer bytes.

INW, OUTW transfer words.

Shift/Rotate

RCL, RCR, ROL, ROR, SAL, SAR, SHL, SHR

Operand Forms:

reg	Shift/rotate register one bit
reg,CL	Shift/rotate register CL bits
B,[addr]	Shift/rotate memory byte
B,[addr],CL	
W,[addr]	Shift/rotate memory word
W,[addr],CL	
[addr]	Default to word
[addr],CL	

Note:

SHL and SAL are the same.

Short Jumps

JA, JAE, JB, JBE, JC, JCXZ, JE, JG, JGE, JL,
JMPS, JLE, JNA, JNAE, JNB, JNBE, JNC, JNE, JNG, JNGE,
JNL, JNLE, JNO, JNS, JNZ, JO, JP, JPE, JPO, JS, JZ,
LOOP, LOOPE, LOOPNE, LOOPNZ, LOOPZ

Operand Form:

value	Direct jump
-------	-------------

Notes:

value must be within -126 to +129 of instruction pointer, inclusive.

JP is NOT Jump on Parity. JP is the unconditional short direct jump. It is retained for historical reasons only and should not be used for new code. Use JMPS instead.

JMPS is the unconditional short jump.

Long Jumps/Calls

CALL, JMP

Operand Forms:

value	Intra-segment direct
value,value	Inter-segment direct (offset, segment)
reg	Intra-segment indirect through register
[addr]	Intra-segment indirect through memory
L,[addr]	Inter-segment indirect through memory ("Long")

Note:

JMP does NOT include the short direct jump. Its mnemonic is JMPS and is included under "Short Jumps".

Return

RET

Operand Forms:

(no operand)	Intra-segment
L	Inter-segment ("Long")
value	Intra-segment and add value to SP
L,value	Inter-segment and add value to SP

String Operations

CMPB, CMPSB, CMPSW, CMPW, LODB, LODSB, LODSW, LODW,
MOVB, MOVSB, MOVSW, MOVW, SCAB, SCASB, SCASW, SCAW,
STOB, STOSB, STOSW, STOW

Operand:

No operand.

Notes:

Those mnemonics with an "S" as their 4th letter are Intel standard and should be used for all new code. Those operands without the "S" as the 4th letter are retained for historical reasons, and generate the same code as the corresponding Intel standard mnemonic. For example,

CMPB is the same as CMPSB

CMPW is the same as CMPSW

Interrupt

INT

Operand Form:

value

Address Manipulation

LDS, LEA, LES

Operand Form:

reg,[addr]	Put effective address in register
------------	-----------------------------------

Segment Override Prefix

SEG

Operand Form:

reg	Must be a segment register (CS, DS, ES, SS)
-----	--

Note:

This opcode should appear on the line immediately preceding the line to be prefixed.

Processor Escape Operation

ESC

Operand Forms:

value,[addr]

value,value

Notes:

The first value is a number in the range 0 to 63 which is internally represented by 6 bits. The leftmost 3 bits from the last part of the first byte of the ESC opcode (the first 5 bits are always 11011). The rightmost 3 bits form the middle section (bits 3,4,5) of the second byte of the ESC opcode. The rest of the second byte of the ESC opcode is determined by the second operand.

If the second operand is [addr], then the second byte of the ESC opcode is set up for the correct addressing mode and possibly a one or two byte displacement is appended to the two opcode bytes. If the second operand is a value, it must be in the range 0 to 7, which is internally represented by 3 bits. These 3 bits are placed in bits 0,1,2 of the second byte of the ESC opcode and bits 6 and 7 are both set to 1.

String Repeat Prefixes

REP, REPE, REPNE, REPNZ, REPZ

No operand.

Notes:

Conditional repeats should be read as "Repeat while ...", e.g., REPE is Repeat While Equal. For those string operations which affect the flags, REP, REPE, REPZ, all repeat while the zero flag is set; REPNZ, REPNE repeat while the zero flag is clear. This opcode should appear on the line immediately preceding the string operation to be prefixed.

All Other Opcodes

AAA, AAD, AAM, AAS, CBW, CLC, CLD, CLI, CMC, CWD, DAA, DAS, DI, DOWN, EI, HALT, HLT, INTO, IRET, LAHF, LOCK, NOP, POPF, PUSHF, SAHF, STC, STD, STI, UP, WAIT, XLAT

No operand.

Notes:

DI is the same as CLI.

EI is the same as STI.

UP is the same as CLD.

DOWN is the same as STD.

HALT is the same as HLT.

LOCK is treated as a separate opcode and should appear on the line immediately preceding the opcode it is to prefix.

3.4 8087 OPCODE CLASSIFICATIONS

All 8087 opcodes normally generate a WAIT instruction before the actual operation code. This wait may be suppressed on any instruction by adding a N to the mnemonic as the second letter, after the leading F. For example, the no-wait form of FCLEX is FNCLEX.

Two-Operand Arithmetic

FADD, FDIV, FDIVR, FMUL, FSUB, FSUBR

Operand Forms:

ST,ST(i)	ST := ST op ST(i)
ST(i),ST	ST(i) := ST(i) op ST
S,[addr]	ST := ST op Short Real
L,[addr]	ST := ST op Long Real
(no operand)	ST(1) := ST(1) op ST; pop stack

Notes:

For FDIVR and FSUBR, operation is "reverse division" and "reverse subtraction", respectively. For example,

FDIVR ST,ST(2) is ST := ST(2) / ST

FADD is same as FADDP ST(1),ST. Likewise for other mnemonics.

Two-Operand Arithmetic with Pop

FADDP, FDIVP, FDIVRP, FMULP, FSUBP, FSUBRP

Operand Form:

ST(i),ST	ST(i) := ST(i) op ST; pop stack
----------	------------------------------------

Notes:

For FDIVRP and FSUBRP, operation is "reverse division" and "reverse subtraction", respectively. For example:

FDIVRP ST(2),ST is ST(2) := ST / ST(2);
pop stack.

FADD is the same as FADDP ST(1),ST. Likewise for other mnemonics.

Load/Store

FLD, FST, FSTP

Operand Forms:

ST(i)

S, [addr] Short Real

L, [addr] Long Real

T, [addr] Temporary Real (illegal for FST)

Notes:

FST may not be used to store the temporary real type.

Integer OperationsFIADD, FICOM, FICOMP, FIDIV, FIDIVR, FILD, FIMUL,
FIST, FISTP, FISUB, FISUBR

Operand Forms:

W, [addr] Word Integer

S, [addr] Short Integer

L, [addr] Long Integer (FILD, FISTP only)

Notes:

Long integer can only be used with FILD and FISTP.

One-Address OperationsFBLD, FBSTP, FLDCW, FLDENV, FRSTOR, FSAVE, FSTCW,
FSTENV, FSTS

Operand Form:

[addr] Operand size is implicit in instruction

Real Compare

FCOM, FCOMP

Operand Forms:

ST(i)

S, [addr] Short Real

L, [addr] Long Real

(no operand) Compare ST and ST(1)

One-Register Operations

FFREE, FXCH

Operand Forms:

ST(i)

(no operand) ST and ST(1) (FXCH only)

Notes:

Only FXCH has no operand form.

All Other Opcodes

FABS, FCHS, FCLEX, FCOMPP, FDECSTP, FDISI, FENI,
FINCSTP, FINIT, FLDLG2, FLDLN2, FLDL2E, FLDL2T, FLDPI,
FLDZ, FLD1, FNOP, FPATAN, FPREM, FPTAN, FRNDINT,
FSCALE, FSQRT, FTST, FWAIT, FXAM, FXTRACT, FYL2X,
FYL2XP1

No operand.

Notes:

FWAIT is the same as WAIT. FNWAIT is not allowed.



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Seattle Computer TRANS

Z80-to-8086 Translator Utility

Preliminary

TRANS
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Seattle Computer TRANS

Z80-to-8086 Translator Utility

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Drive, Seattle, WA 98188.

Part Number 900-002099

System Requirements

Seattle Computer Products TRANS requires:

3K bytes of memory minimum



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CHAPTER 1

INTRODUCTION

The Seattle Computer Products Z80-to-8086 translator accepts as input a Z80 source file written using Zilog/Mostek mnemonics and converts it to an 8086 source file in a format acceptable to ASM, the Seattle Computer Products assembler.



CHAPTER 2

USING TRANS

To start TRANS, type:

```
TRANS <filename.ext>
```

Regardless of the original extension, the output file will be named <filename>.ASM and will appear on the same drive as the input file.

The entire Z80 assembly language is not translated. The following opcodes will result in an "opcode error":

```
CPD    CPI    IM     IND    INDR  INI    INIR   LDI    OTDR  
OTIR   OUTI   RLD    RRD
```

Only the following pseudo-ops are allowed:

```
DB     DM     DS     DW     EQU    IF/ENDIF  ORG
```

Any others will generate an "opcode error".

2.1 TRANSLATION NOTES

IX, IY, and the auxillary register set are mapped into memory locations, but these locations are not defined by the translator. If a file using these registers is translated and assembled, "undefined label" errors will result. The file must be edited and the memory locations defined as follows:

IX:	DS	2	
IY:	DS	2	
BC:	DS	2;	Auxillary register set definition
DE:	DS	2	
HL:	DS	2	

Since IX and IY are mapped into memory locations [IX] and [IY], a memory load or store of IX or IY will translate into a memory-to-memory move. LD IX,(LOC) would become MOV [IX],[LOC]. This is easily corrected by editing and using a register:

```
MOV DI,[LOC]; MOV [IX],DI.
```

All references to the I (interrupt) and R (refresh) registers will generate an error when the translated file is assembled. The "I" and "R" designations are passed straight through, so that LD I,A becomes MOV I,AL, which would appear to be an attempt to move AL into an undefined immediate.

Blank spaces must not occur within operands. Blanks are equivalent to commas in separating operands.

The input file is assumed to assemble without errors with a Z80 assembler. Errors in input may cause incorrect translation without an error or warning message.

The BIT, SET, and RES instructions require the bit number to be a single digit, 0-7. Use of a label for a bit number, for example, will result in "cannot determine bit number" error.

DJNZ is translated into a decrement followed by jump-if-not-zero. DJNZ, however, does not affect the flags while the decrement does. This is flagged as a warning in the output file and may require special action in some instances.

The parity flag of the 8086 will always be set according to 8080 rules and therefore may not be correct for the Z80. Any jump on parity is flagged with this warning.

2.2 ASSEMBLY NOTES

It is likely that a translated program will be flagged with some errors when assembled by ASM. These errors are usually caused by out-of-range conditional jumps. Since all 8086 conditional jumps must be to within 128 bytes, this type of error is corrected by changing the conditional jump to a reverse-sense conditional jump around a long jump to the target. For example:

JZ FARAWAY

becomes

JNZ SKIP1
JMP FARAWAY

SKIP1:

Other assembly errors may occur because the assembler does not have all the features found in some Z80 assemblers. For example, ASM cannot handle logical operators in expressions. These errors can only be corrected by finding a way not use the missing feature.





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Seattle Computer HEX2BIN

Hexadecimal-to-Binary Conversion Utility

Preliminary

HEX2BIN
Utility



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Seattle Computer HEX2BIN

Hexadecimal-to-Binary Conversion Utility

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Drive, Seattle, WA 98188.

Part Number 900-

System Requirements

The Seattle Computer Products HEX2BIN requires:

3K bytes of memory minimum



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CHAPTER 1
INTRODUCTION

HEX2BIN is a utility that converts files in Intel hex format to binary format. Intel hex format files are produced by the Seattle Computer Products Small Assembler (ASM).



CHAPTER 2

USING HEX2BIN

To start HEX2BIN, type:

```
HEX2BIN <filespec> [offset]
```

where: <filespec> is the name of the hex file to be converted. If no extension is given, .HEX is assumed. A file of the same name but with an extension of ".COM" is produced which is the absolute binary equivalent of the hex input file, offset by the optional offset parameter or by the default offset of -100 hex if no offset is specified.

[offset] is optional. The default offset is -100 hex if no offset is specified. To use the offset, it is necessary to understand just what HEX2BIN does:

First, as large a segment as possible (limited to 64K and available memory) is set aside as the load segment. This segment is filled with zeros. Then the .HEX file is read piece by piece and decoded. Each time a load address is encountered in the .HEX file, the offset is added to it modulo 64K and loading continues at that point. The highest location loaded is also kept track of. The loading process is aborted if the load address (with offset added to it) exceeds available memory. After loading, the file is saved starting at location 0 in the segment, up to the highest location loaded.

Normally, a program intended to become a .COM file will be assembled with a PUT address of 100 hex, since this is where it will execute. However, the program must actually be written starting right at the beginning of the .COM file because the file itself is loaded at 100 hex. This requires a load

offset of -100 hex, which is the default offset if none is specified. That is, if no offset is specified (no second parameter to HEX2BIN), the file will be loaded (and saved) at location 0. When the file is later loaded as a command, it will load at 100 hex which is its proper execution address.

The offset parameter is particularly useful when converting a file not intended as an MS-DOS .COM file. The parameter has an optional + or -, then a hex number with one to four digits. Note that if an offset of 0 is desired, it must be specified explicitly since the default is -100 hex.

Comment Form

Use this form to comment on this product and to report software problems or errors in the manual. (If you are reporting a software problem, attach a listing if possible.)

Software Description:

Software Product _____ Version No. _____

Operating System _____ Version No. _____

Other Software Information _____

Hardware Description:

Seattle Computer Model No. _____ Memory Size _____ KB

Media: Size _____" Format: Sides _____ Density _____

Other System Hardware _____

Comments:

Name _____ Company _____

Street _____

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Phone _____ Date _____

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Fold and tape

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stamp
here

Seattle Computer Products
1114 Industry Drive
Seattle, WA 98188

Attn: Software Support

Fold and tape

